

# Popular Science

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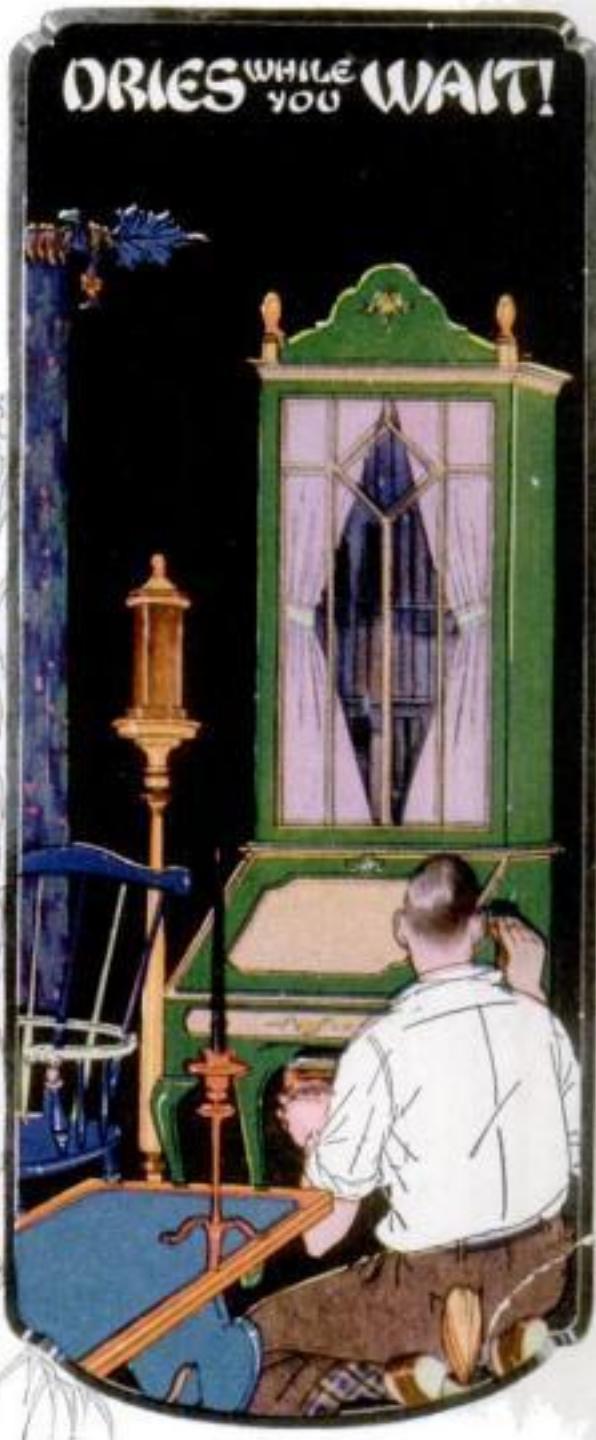
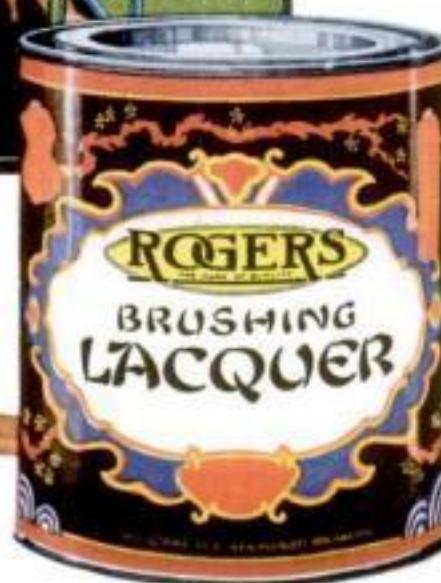
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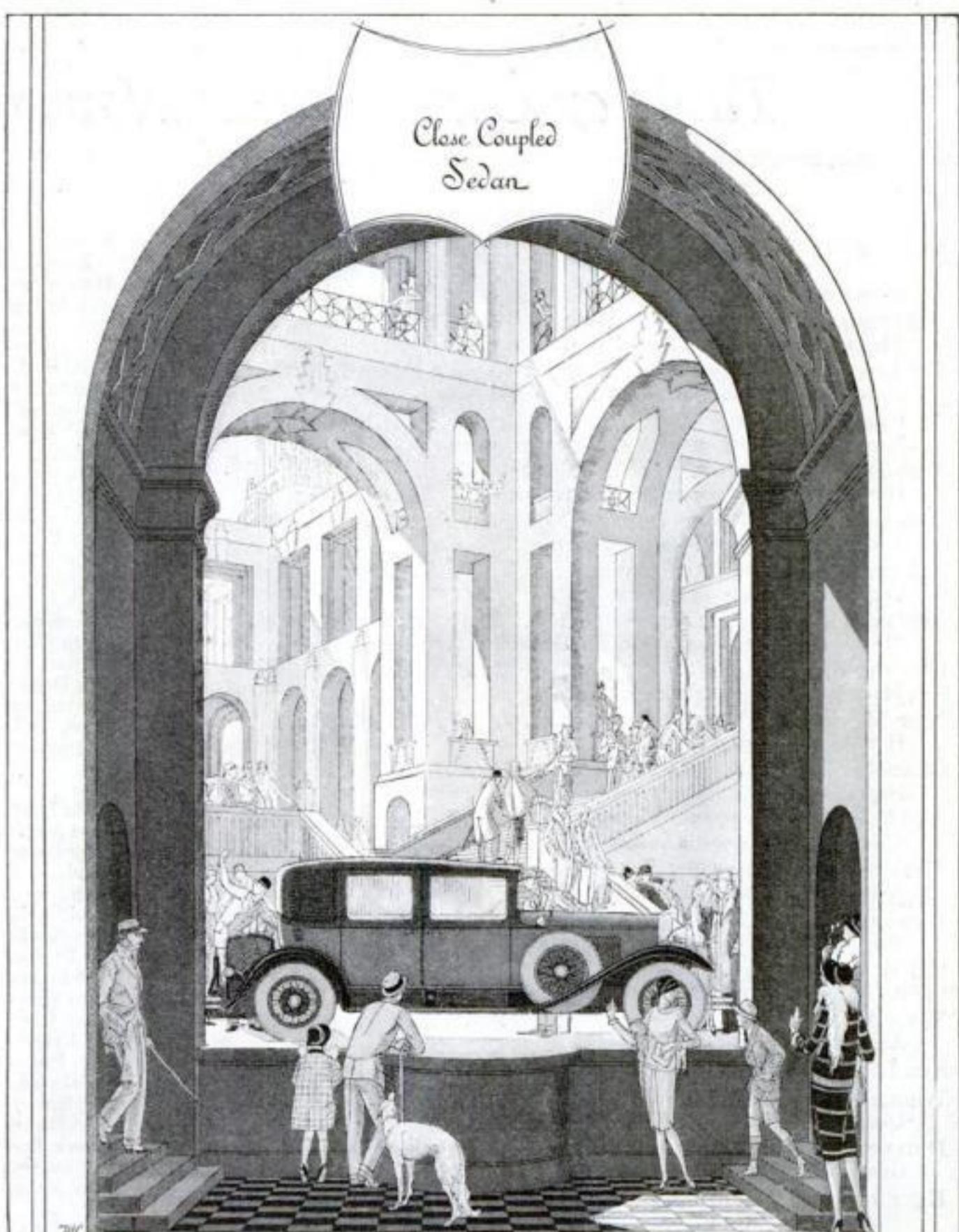
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name and address in the margin below—then tear it off and mail to us and we will send you a free copy of the Edison Year Book with list of our current investment offerings and details of the Monthly Savings Plan.



# HOW ROGER BATES Invested His Money

By WALLACE AMES, *Financial Editor*

FIFTY years ago, in the little city of Auburn, a lumber business was established by Dudley Bates. A few years later it became Bates & Son. When old man Dudley died in 1900 the business was continued by his son, Roger. Through square dealing and sound merchandising the company steadily grew into a very sizable enterprise, until the little lumber yard that was started with \$3,000 capital had a rating of \$100,000.

And Roger himself was getting along in years. Having stuck strictly to business for nearly four decades, never taking more than an occasional two weeks of vacation and never getting far away from Auburn, Roger decided it was time to retire. So the old lumber business was sold, Roger receiving \$50,000 in cash and the rest in stock of the new corporation. The other day the money was paid over and for the first time in his life Roger had a considerable sum to invest.

Since he had been successful in his own business Roger had complete confidence in his ability to invest the large sum of cash that came into his hands when the lumber business was sold. Accustomed to making his own decisions, it was perfectly natural for Roger to make up his mind as to how the \$50,000 was to be invested. So when he went down to New York to call on an investment banking firm, whose advertisements had often attracted him, he had a pretty definite idea as to how he was going to invest.

"TELL me all about it," said Judith, with eager interest, when he returned to the hotel room late that afternoon.

"I was never so surprised in all my life," exclaimed Roger, by way of beginning his account. "Those bankers had just the bonds I intended to buy, but they would not sell them to me. And such a line of questioning as they put me through. They wanted to know how much we were worth, what our source of income was, what property we owned, how much insurance I was carrying, whether we had any dependents, what time of year we paid out large sums for taxes, insurance premiums, etc., what our future plans were, and a lot of other things."

"The fresh things! I hope you told them where to get off," expostulated

Judith, her excitement causing her to indulge in a little slang that was rather foreign to her usual manner.

"That is just the way I felt at the beginning," said her husband, "but I soon learned that there was method in their madness. The manager who was attending to me explained that most of the bonds I wanted to buy were good bonds, but not well suited to our particular circumstances.

"Since we are from now on going to live on investment income he explained that we should not take what he termed 'a business man's risk!' Nor did we need a high degree of what he called 'marketability' since what we wanted was a dependable income rather than the ability to sell our bonds at a moment's notice to use our money for some other purpose.

"THEN the manager pointed out that some of the bonds I wanted to buy would eventually have to pay a very heavy inheritance tax since they were subject to tax in several states. And there were a lot of other things he went over with me, almost too numerous to mention.

"In fact, that outfit seemed in no hurry to sell me any bonds. They made a lot of notes and asked me to see them again tomorrow when they would have a list of recommendations."

The next morning he and the manager went over a list of recommendations and made the final selections. Then since Roger and Judith were going abroad for several months the banker arranged to care for their securities, collect and remit income and attend to all details while they were away.

"I was beginning to think that the service we hear so much about was mostly bunk, but you have shown me that the word still has all of its old-fashioned meaning," Roger remarked, as his transactions were completed.

\* \* \*

In these days any investor can obtain much valuable service and assistance by establishing himself with a reliable investment banker. These firms are doing more and more, constantly finding new ways, to help people accumulate money and invest it wisely.

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## How Roger Bates Invested His Money

(Continued from page 4)

vestments of individuals. If a list is not well diversified, if it contains some "weak sisters," if any bond is likely to be called soon, or is selling at a price that shows the owner a nice profit, such things are pointed out and changes recommended.

One house has a little booklet from which we quote the following: "While we should like to interest you in the offerings which we have for sale, we will suggest only those securities which we believe to be best suited to your particular needs." Then follows eleven pages of questions with spaces for the answers, one page for a trustee, another for business reserve investment, one for the treasurer of a religious, fraternal, or other organization, and still others for the business man or woman, the professional man, the retired individual, the heir, the widow, the man or woman living entirely on income from investments, etc.

Making sound investments is a profession. It requires the same grade of skill that it does to be a good doctor or a capable lawyer. The successful merchant, the master mechanic, the eminent writer or the talented architect when left to his own devices would probably make a great botch of his investments. His skill and training do not run that way. Nor does he have the facilities to reach sound conclusions in investment matters. Such work as this should be done by specialists. And you can get such specialized service without cost if you tie up to any one of the many reputable investment banking firms who seek to gain your business by serving you well and skillfully.

## To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

**How to Build an Independent Income** (1927 Edition)—Describes a plan for buying 6½% First Mortgage Bonds by payments of \$10 or more a month, and shows the results that may be accomplished by systematic investment. Address: The F. H. Smith Company, Smith Building, Washington, D. C. Ask for Booklet 75.

**The House Behind the Bonds** reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill. **Behind the Scenes where Bonds Are Made** tells how you can retire in fifteen years and have an income equal to your present living budget. This booklet can be secured by writing to Cochran and McCluer Company, 46 North Dearborn Street, Chicago, Ill.

**Thirty-two page illustrated booklet**, describing one of the largest public utility companies, of interest to investors. Utility Securities Company, 230 S. LaSalle St., Chicago, Ill.



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*A-battery eliminators are shown here undergoing test. The radio buyer is wise in making his selection from equipment that has passed The Institute's tests.*

**S**WITCHING on a radio from the electric current supply has always been the ambition of radio owners and now radio engineers are ready to satisfy that demand.

More careful consideration should be given to the selection of electric sets and battery eliminators than any other type of apparatus, however.

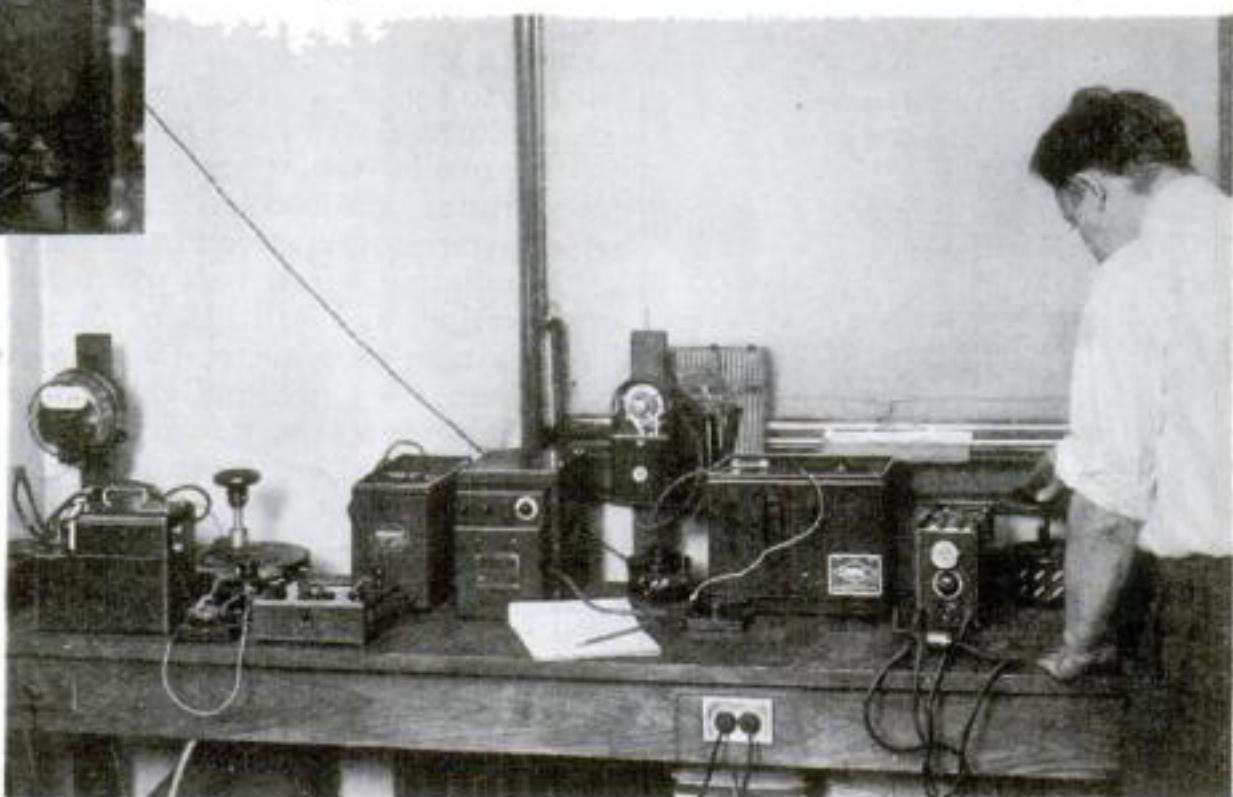
In the first place, there are many products on the market of this nature that are still in the experimental stage and are not capable of giving even a fair degree of satisfaction. This means extra vigilance on the buyer's part if he is to get reliable equipment.

The fact that there is a larger percentage of poor apparatus among this particular type of equipment does not mean that the theory on which they are constructed is impracticable. The entirely different faults found in different makes prove this and show that the designers merely slipped up on certain points. This situation has been the case in past years when new types of equipment were brought out and needed further perfection.

In the matter of selecting reliable apparatus of this type, POPULAR SCIENCE MONTHLY can definitely aid its readers. In the magazine and in the new list of approved equipment issued, will be found advertised and listed those electrically operated radio receivers and accessories that have been found reliable by the Popular Science Institute of Standards after most thorough tests.

To the reader contemplating the purchase of any such equipment, The Institute approval provides assurance that these products are (1) properly constructed of high grade parts, (2) are reasonably efficient in the use of electric power, (3) are free from serious

# Keep These Points in Mind If You Use ELECTRIC SUPPLY for Your Radio



deficiency as to the amount of hum or noise they will produce or cause, (4) will have a reasonably long life with a minimum of attention or replacement, (5) are correctly rated by the manufacturer and (6) under suitable conditions of operation, provide a brand of performance that is consistent with their price and type.

Then the buyer of electrically operated equipment has another very important thing to consider. That is the matter of making certain that the apparatus selected is suited to the light supply in the particular locality in which he lives. The proper operation of some types of such equipment—particularly complete electric receiving sets and, more so, "A" socket power devices of the true eliminator type containing no batteries or other form of regulators—is dependent on the voltage characteristics of the electric supply line to which they are connected.

It is important, therefore, in purchasing such devices to be further guided to a specific choice by the experience of a reliable local dealer who has tested these devices under conditions that are similar to those in your home. This applies to both electric sets and socket power devices. In the case of the latter, there is still one

more important consideration. The power units must be suited to the receiving set with which they are to be connected. To make sure of this follow the set manufacturer's recommendations or arrange with your local dealer for a home trial.

\* \* \* \* \*

A 20-page booklet on buying, installing and operating a radio outfit, which also contains a list of reliable tested equipment, can be secured from the Popular Science Institute, 250 Fourth Ave., New York, for 25 cents.

## Popular Science Monthly G U A R A N T E E

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY.

THE PUBLISHERS

# Don't confuse Balkite "AB" with so-called radio socket powers



**Balkite "A"** Contains no battery. The same as Balkite "AB" but for the "A" circuit only. Not a battery and charger but a perfected light socket "A" power supply. One of the most remarkable developments in the entire radio field. Enables owners of Balkite "B" to make a complete light socket installation at low cost. Price \$32.50.



**Balkite "B"** One of the longest lived devices in radio. The accepted tried and proved light socket "B" power supply. The first Balkite "B," after 5 years, is still rendering satisfactory service. Over 300,000 in use. Three models: "B"-W, 67-90 volts, \$22.50; "B"-135, 135 volts, \$32.50; "B"-180, 180 volts, \$39.50. Balkite now costs no more than the ordinary "B" eliminator.



## Balkite Chargers

Standard for "A" batteries. Noiseless. Can be used during reception. Prices drastically reduced. Model "J,"\* rates 2.5 and .5 amperes, for both rapid and trickle charging, \$17.50. Model "N"\*\* Trickle Charger, rate .5 and .8 amperes, \$9.50. Model "K" Trickle Charger, \$7.50.

\*Special models for 25-40 cycles at slightly higher prices

Prices are slightly higher West of the Rockies and in Canada

The new Balkite "AB" marks another great advance in radio power by Balkite—the pioneer and leader in the radio field. It replaces both "A" and "B" batteries and supplies radio current from the light socket. It is not to be confused with so-called radio socket powers. It contains no battery in any form, nor any of the other usual accessories. It never requires charging.

*It contains no battery in any form*

famous Balkite principle of electrolytic rectification. A principle so reliable that it is standard on the signal systems of most of the railroads of the country. A principle that has been responsible for nearly all the great advances in radio power. The same principle on which 2,000,000 Balkite units now in use are based. Like all other Balkite units Balkite "AB" is entirely noiseless, a permanent piece of equipment, with nothing to wear out or replace.

### Operates only during reception

Balkite "AB" operates only during reception. Turn it on and your set operates. Turn it off and reception stops. Operating only during reception, it is extremely economical. There is no trickle charging when it is not in use. It puts an end forever to run-down radio power. It delivers at all times a full, even, uniform flow of current exactly as required. It always uses the least current necessary to operate your set satisfactorily. It requires no other attention than the addition of water 3 or 4 times a year. It is unaffected by standing idle.

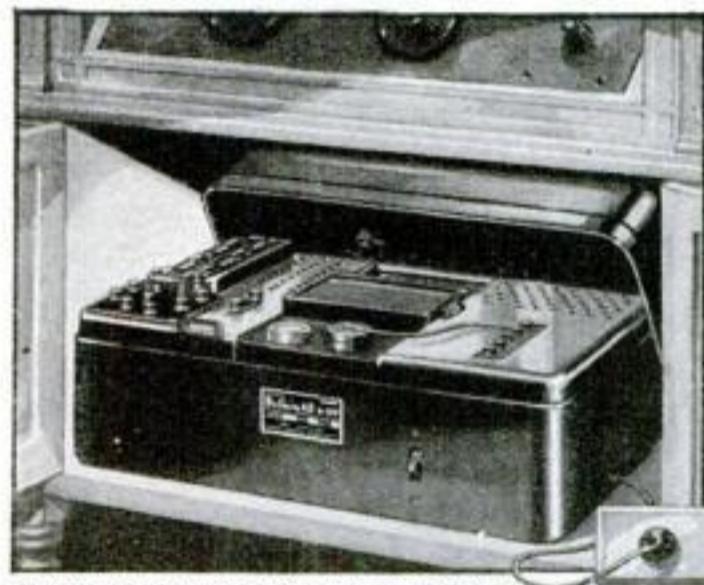
Balkite "AB" is based on the

### Makes any set electric

Balkite "AB" makes any receiver an electric set, a true instrument of pleasure. To realize the difference between Balkite "AB" and any other radio

power supply, just lift the lid and look. There is no confusion of wires, nothing to go wrong. Instead a simple complete unit that means the swift passing of radio batteries and their attendant cares. Two models, to serve any set. 135 volts\*, \$59.50. 180 volts, \$67.50.

Your dealer will recommend the one you need.



**Balkite "AB"** To realize the advantages of Balkite "AB," just lift the lid and look. There is no confusion of wires, nothing to go wrong. Instead a simple complete unit that means the swift passing of batteries and their cares. Particularly a boon to women.

FANSTEEL PRODUCTS COMPANY, Inc., North Chicago, Illinois

FANSTEEL

# Balkite

## Radio Power Units



Transmitting messages with his drum, the African depends on the pitch and clarity of its tone. With amazing speed these messages are sent over miles of mountains and jungle.



**TONE** — Full, deep, resonant — unequalled in its naturalness. As the music is played, as the artist sings, so you should hear it — true, rich, life-like — so faithfully reproduced that you forget you are listening to radio.

This is what you enjoy with a Grebe Synchrophase Seven, particularly in combination with the Grebe Natural Speaker: A

tone quality that is unrivaled for its naturalness, an ease of operation that is remarkable for its simplicity, and a refinement of appearance that harmonizes with any environment. Grebe Synchrophase Seven, \$135; Grebe Natural Speaker, \$35. Send for Booklet P; then ask your dealer to demonstrate.



A. H. Grebe & Company, Inc., 109 West 57th Street, New York City  
 Factory: Richmond Hill, N. Y.      Western Branch: 443 So. San Pedro St., Los Angeles, Cal.

*The oldest exclusive radio manufacturer*



NOVEMBER, 1927

SUMNER N. BLOSSOM *Editor*

VOL. III, NO. 5

# *"I'm Going to Raise My Boy to Be a Plumber"*



Drawing the  
thing at \$7 a  
day while  
others build  
it at \$14

## An Answer to the Widely Discussed Question, Does Education Gained in a College Really Pay?

**S**TILL pounding the pavements, job hunting," said Freddy Vail when I met him recently. "I've been at it since June.

"Oh, I can get plenty of jobs—at \$20 a week! But even at that price they tell me I'll be an expense to the company for a year or so, while they're educating me.

"Educating me! And for what have I spent four of my own best years, and five thousand of my dad's hard earned dollars—if not for an education?"

Freddy Vail, I think, fairly represents the average among some thirty thousand college men who were graduated last spring with a liberal education and no specific training for a life work.

Fred, like hundreds of his fellows, after enjoying the advantages of college is now up against life as it is—and he hasn't the remotest notion of what he wants to do.

By

KENNETH WILCOX PAYNE

Nor has he learned how to do anything for which employers pay salaries.

I know a smart young plumber of Fred's own age who is earning \$60 a week, supporting a wife and baby and driving his own little car to work.

Freddy Vail has a college education. But Joe Brace, the plumber, has a head start in the business of living.

The day I last talked with young Vail I chanced to run across the following passage in McNaught's Monthly, written by Armand R. Miller, principal of the Roosevelt High School in St. Louis.

"There is an unfortunate tendency for high school boys to avoid the trades. The status of the skilled mechanic is now

so favorable that the trades should be a very attractive field even for graduates of high school . . . Many a \$25-a-week clerk might have been a \$75-a-week plasterer or a \$200-a-week plastering contractor."

That passage, coming from an educator, set me to thinking about my own son's future. I discussed the subject later with a group of acquaintances. One started life as a carpenter; today he has a prosperous business of his own, has built a fine home and bought an extra car for his wife. Another is a chemist, graduate of a large western college; he's a brainy, likable chap—in personality quite comparable to the former carpenter—but he's stuck in a salaried job at \$4,000 a year.

"I'm going to raise my boy to be a plumber," said the chemist.

Considerably more than a hundred thousand boys among the seniors in

American high schools this fall are preparing to go to college. Approximately a million and a quarter of all the boys now in high school know that they can't go to college. And many of them feel that they are going to miss something vital to success in life. Are they?

Should the whole hundred thousand go? Should the others be disappointed? What are the facts? What is the value of a college diploma, anyhow?

Freddy Vail values it thus:

"I wish I had a union card instead of a diploma. The plasterer who made repairs in our fraternity house last spring was getting \$13 a day. For eight hours labor he gets more than half of what I'm offered for a whole week's work. And at the rate of advancement I'm promised it may be eight or ten years before I catch up to that plasterer's annual income."

"When I left high school, the question of whether I should go to college was seriously debated. I read somewhere that a college education would add \$72,000 to my future earnings. And now with an A.B. degree I'm worth less money on the open market than an unskilled laborer!"

**F**REDDY isn't exaggerating. The starting salary for liberal arts graduates is about \$1,300 a year. A hod carrier gets \$88 or \$90 a day; the average earning of common labor in American factories is slightly above \$23 a week and it reaches \$27 or \$28 in certain industries—automobile, iron and steel, and rubber.

Of course statistics show that the college graduate forges ahead rapidly and soon outdistances the untrained man. But there are more kinds of training than university training. At thirty, the graduate of overalls may make \$120 a week supervising electricians who make \$60, while the graduate of cap and gown at the same age may be earning \$50 a week at a white collar job.

To the parents of nearly twenty million children in our public schools it must be an increasingly important question whether the particular variety of training offered by the college is the only kind of training for their sons.

The assumption that it is dominates American life today. High school boys are going to college in unprecedented numbers. Between 1920 and 1922 the increase in college registration was 50,000. The next following two years it was 187,000. And there are probably close to half a million men registered in the colleges this fall. In a few decades the proportion of men in institutions of higher learning has risen from less than one percent of youths of college age to fully eight percent. And the increase in college attendance now goes on at the rate of nine percent a year.

**A**S THE colleges become overcrowded, the teaching of those who have logical need for being there is hampered by the presence of many who are there chiefly because it is the fad. It is said that twenty out of a hundred boys are mentally equipped for college studies. Twelve out of the twenty can't go—largely for economic reasons. Of the remaining eight who start college, only three get through. Five eighths of the boys who seek a college diploma fail to

achieve their goal. Many, after spending two or three years in the attempt, aren't as well off as the more ambitious of the fellows who started work at sixteen.

Ten years ago there were 164,000 men in college. It is estimated that the average liberal arts graduate from among them is making no more than \$3,000 or \$4,000 today.

If there's anything to the law of supply and demand, what will be the salaries commanded by college graduates in white collar jobs when the half million men now in academic halls are competing on the open market?

Aren't you willing to bet that the skilled craftsman, who is already neck-and-neck with the white collar graduate of ten years ago, will be more than holding his own with the next ten years' increased supply of college men?

At least one consequence of the present deluge of diploma seekers is plain. The more students go to college, on the one hand, and the higher the colleges raise their **fees** to keep out the flood on the other, the more college becomes a social ambition.

**H**ENCE thousands of parents are now making serious sacrifices to gratify this ambition for their sons. The actual cost of a college education, furnished from his own experience by a Cornell man working his way through, is between \$1300 and \$1400 a year. Other estimates put it at \$1500.

That is more than the average individual income of all American wage earners. An investigation at Yale indicates that students whose family income is less than \$5,000 must help support themselves in college. And yet only a little over three percent of all American incomes are over \$5,000 a year. Obviously



Men who work in overalls look over the situations that allow them leisure in white collars

\$1500 out of even a \$6,000-a-year income leaves a big hole. It is estimated this fall that there are close to 800,000 students (men and women) seeking college degrees. But there aren't within 200,000 that many Americans with incomes over \$6,000.

In other words, for a good many college students, the degree must be won at heavy sacrifice, either by dad who pays the bills, or by the son who works his way. Last year, in a typical mid-western university, 15 percent of male students earned all their college expenses; and 63 percent were earning part of them. In an eastern university the proportion was 31 percent of self-supporting students.

Of the boys who are cast entirely on their own resources for college expenses, Dean Herbert E. Hawkes, of Columbia, has said:

"IT IS always to the detriment of their health or the value of their education or both . . . To see boys by the dozen take jobs lasting from six o'clock in the evening until two in the morning, six days in the week; to see boys undergoing transfusions of blood to get money for their books, is a heartrending spectacle."

Is the college education worth the sacrifices?

Hundreds of the self-supporting students work at menial jobs—as dishwashers, waiters, snow-shovelers, chauffeurs and gardeners. The strain, according to Dean Hawkes, is an important reason for the student's failure to be graduated. And such jobs give no vocational training. The boy who has elected to take up a trade is getting vocational training at the same age.

And as for education—well, nobody questions its value whether calculated in cash or culture. But education is a life-long process; in these days it is available from many sources to all who really want it. And the least educated men of my acquaintance are those who think their

### Both Sides of the Question

**N**o SUBJECT is more generally discussed and more seriously weighed than this to which Mr. Payne, college **trained**, reporter, editor and father, has given long and careful thought after searching inquiry and investigation. What he has to say is important to every youth and every man with sons.

There is, of course, another viewpoint, and next month POPULAR SCIENCE MONTHLY will present, "Why I am Going to Send My Boy to College," by J. B. Minnerly, a master plumber, of White Plains, N. Y.

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# Is Flying Really Safe?



This plane's motor failed in a Boston fete. Sergeant Cobb barely avoided hitting a hospital and plunged into the Charles River. Miraculously both Cobb and his passenger climbed out alive.

## The Answer Is: Not Yet—Twenty-five Deaths in Ocean Flights in Year, Scores of Mortalities on Land Prove Conquest of Air Remains to be Achieved

**C**OLONEL LINDBERGH, Commander Byrd and other popular heroes of aviation have recently been quoted as complaining of the difficulties of convincing the public that flying is safe. Giving those gentlemen all due credit for technical skill and splendid accomplishments, there is a growing conviction that the public should not be convinced the air today is safe.

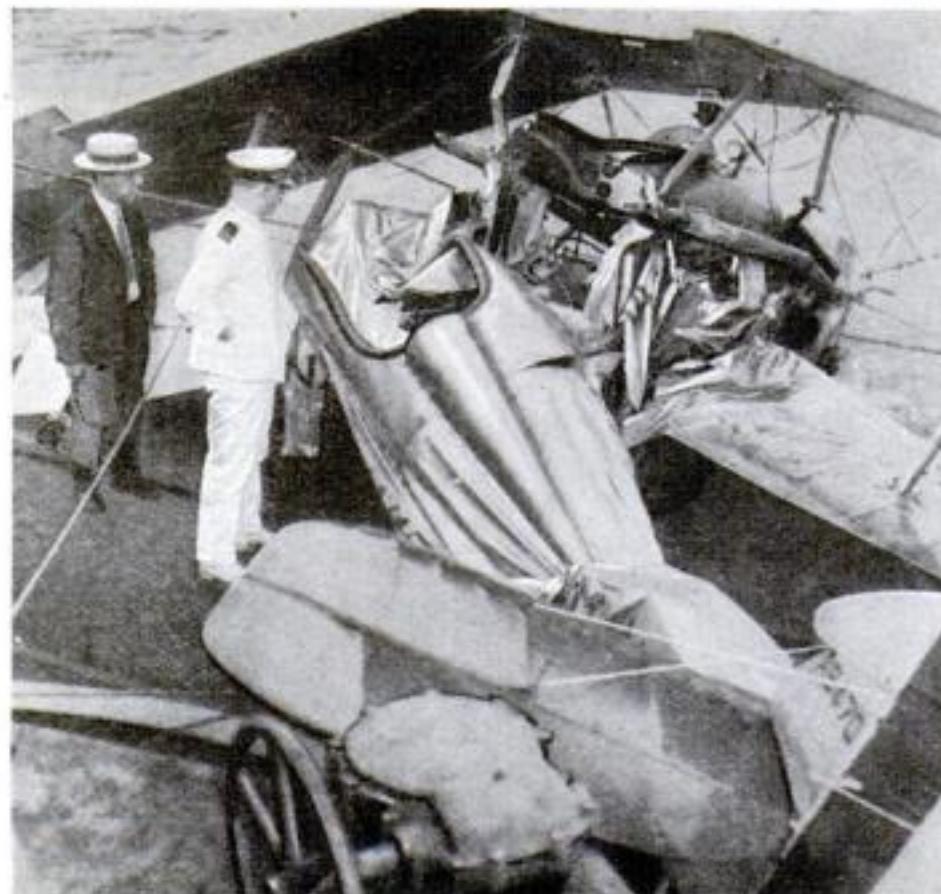
Flying is not yet safe. Safe for Lindbergh and Byrd—so far. But the average person makes no fine discriminations. When he is told that aviation is safe, it means that flight compares in safety favorably with other transit means.

What one group of men thinks of the safety of flying is shown in a resolution recently adopted by the American Bar Association. Proposed by the Committee on Air Law, it urges Congress to empower Government officials to regulate ocean flights and curb "stunt flying."

"**O**N TRANS-OCEANIC flights," says C. W. Cuthell, chairman of the committee, and incidentally, general counsel of the Curtiss Aeroplane Company and the National Air Transport Company, "approximately twenty-five lives have been lost during the present year. Most of the

By GEORGE LEE DOWD, JR.

flights are not of a directly commercial nature. They are what we of the profession call stunt flights." The control Mr. Cuthell advocates is declared necessary by several flying organizations, though Government departments see in it the danger of prohibiting air pioneers from necessary experiments.



The wreck of the airplane in which Commander John N. Rodgers, Hawaiian flight hero, ended his career. Rodgers fell into the Delaware River at Philadelphia Navy Yard and after being rescued died of injuries and shock.

The Australian Government has announced that stunt flying will be prohibited. Similar curbing is projected in Canada. Distinguished publicists in Germany and England have urged an end of spectacular flying that accomplishes no advancement of aviation science.

Today aviation is about where railroading was before George Westinghouse invented the airbrake. And in science and invention and their application to its problems lies its hope for the future. Heroic pioneers are striving at the risk of their lives and money to make aviation safer and more practical. But no good purpose can be served by closing our eyes to the developments necessary before real safety can be achieved.

**U**NFORTUNATELY, however, there seems to be a tacit agreement among people interested in aviation not to discuss the dangers of flying. That last sentence is not mine. It is a direct quotation from a recent utterance by Harry F. Guggenheim, president of the Daniel Guggenheim Fund for the Promotion of Aeronautics. Mr. Guggenheim is the principal figure in the group of aviation enthusiasts under whose auspices Colonel Lindbergh is touring the United States. Listen to him further: "This traditional taboo of

the subject of safety probably can be traced to a desire on the part of aviation's early priesthood to protest against the existence of dangers which they had no means of overcoming. I can conceive of no more stupid policy than continuing this traditional silence which has left the public so completely ignorant of the cause of aviation that it grossly exaggerates these dangers and ignores the elements of safety in flying. . . . This misapprehension on the part of the public cannot be overcome by any amount of shouting that aviation is 'perfectly safe': it must be overcome by giving the public the knowledge of aviation which they today so woefully lack. And one way to enlighten the public is through a full and frank discussion of everything about aviation, including its dangers and the manner in which they have been and are being overcome."

POPULAR SCIENCE MONTHLY has taken the lead among periodicals of wide circulation in "giving the public the knowledge of aviation," which it demands more eagerly now than at any time since the pioneer flights of the Wrights and Curtiss, and its editor has asked me to discuss frankly flight—"its dangers and the manner in which they are being overcome."

AS I write the *Old Glory*, on the way from America to Rome with Lloyd Beraud, James D. Hill and Philip A. Payne, is lost somewhere off Newfoundland, probably raising the Atlantic flight death list for the year to thirteen—eleven mortalities at sea and two in trial hops.

Rescue parties are still tracking down faint clues as to the fate of the lost trans-Atlantic plane *St. Raphael*, which left England for Canada, with Lieut. Col. F. F. Minchin, Capt. Leslie Hamilton, and Princess Lowenstein-Wertheim.

Another English flyer, Capt. Courtney, was forced down in Spain after being blown off his course on an attempted flight to America. Leon Givon, French aviator, was turned back to France when heavy fogs balked his initial attempt to span the ocean.

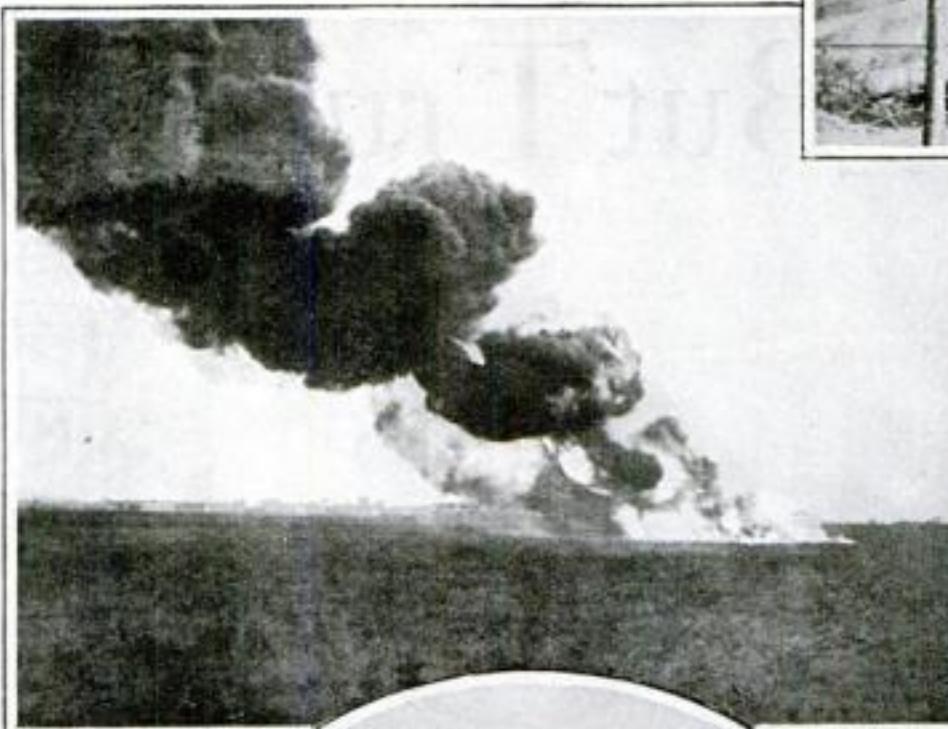


All that was left of the low-winged monoplane in which George Covell and R. S. Waggener, U. S. N., crashed to death on their way to enter Honolulu Air Derby

Fonck's "flight to Paris" is seen in the ironic photograph below. Never leaving the ground, the plane was in flames in two minutes. Two of the crew perished



Flying is not so safe, the passenger who escaped with broken bones and cuts from this plane wreck near Lowell, Mass., will tell you. The pilot survived



start of the race. Two more turned back, with disabled engines or damaged planes. Only two out of the thirteen reached Honolulu, and one of those only with difficulty. Two men in another plane, starting to search for the missing ones, also vanished, leaving no trace but the tragic farewell radio message to the world: "We are in a tail spin SOS!"

That kind of aviation certainly is not safe.

Only one airplane has flown from the North American continent to the continent of Europe without mishap. That was Lindbergh's. Coli and Nungesser have never been heard of since they started from Paris. The *America* flew all over western France until it was forced down. "We are going to crash" wrote Commander Byrd on the note he handed to his

companions, and crash they did, with a few broken bones and the narrowest of possible escapes from sudden death. Chamberlin and Levine landed in a German bog, at the cost of a smashed landing gear. The *American Legion*, attempting to start for Europe, crashed at Langley Field last April, killing Commander Noel Davis and Stanton Wooster. Paul Redfern was lost in an effort to fly from Brunswick, Ga., to Brazil. Some months earlier Fonck's giant Sikorsky plane, built for a trans-Atlantic flight crashed at the start-off, killing two of its crew. The two German Junkers planes which started for America were forced to turn back because of weather conditions.

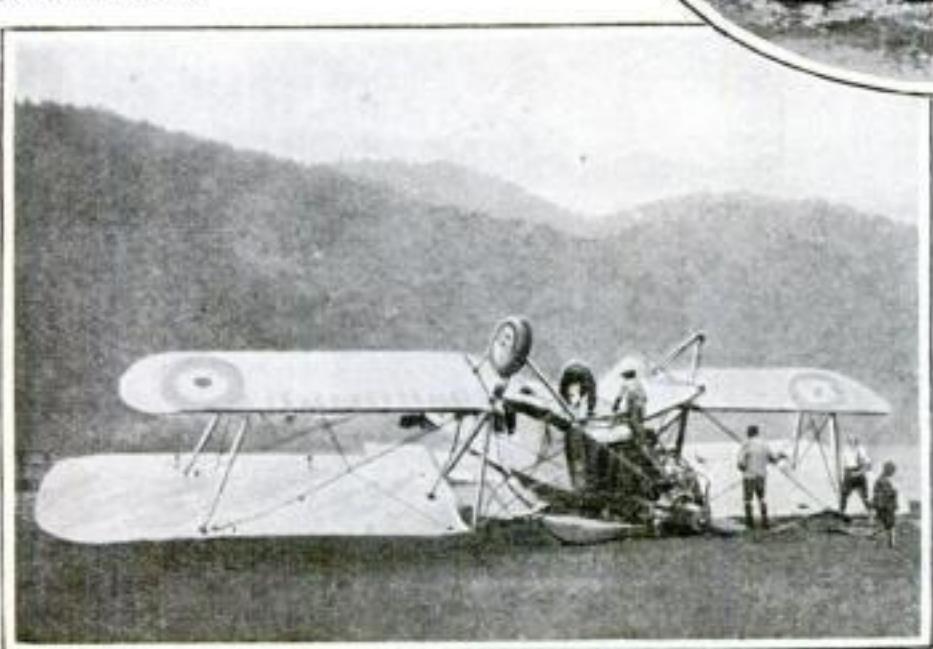
Two of the flyers on the Pan-American Good-Will flight under the command of Major Herbert (Continued on page 135)

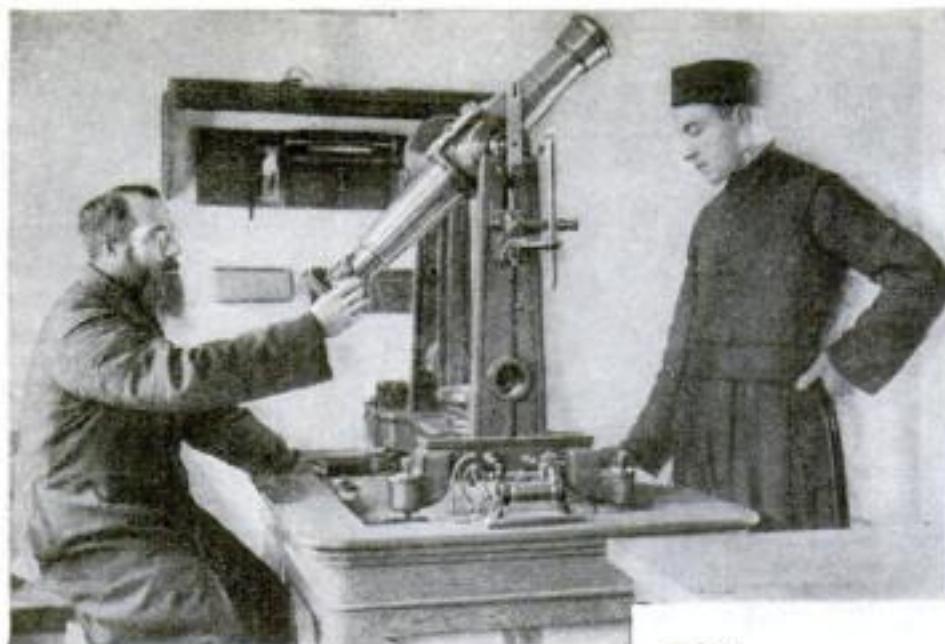


Wreckage of the *America* in which Commander Byrd and crew were forced down at Ver-sur-Mer in their effort to reach Paris. Facing death, all escaped by good luck

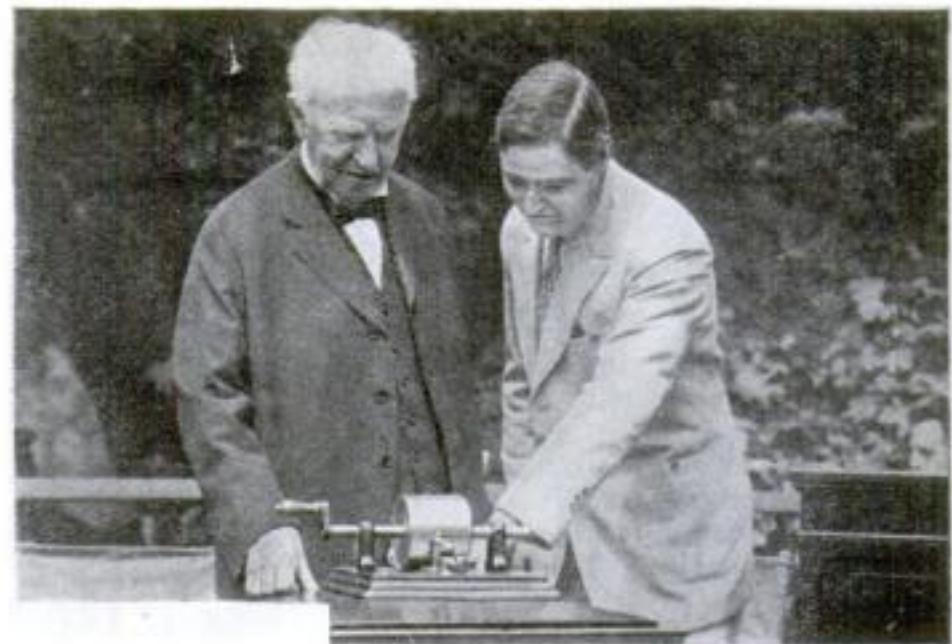


Left: How the London-India flight of C. R. Carr and E. C. Deasth ended in Austria. Their biplane hurtled into the Danube River and both men were severely injured. Picture shows remains of the salvaged plane





**Measuring to Shanghai** At Shanghai's new observatory this "transit" determines its distance from Greenwich zero meridian within three yards



**Phonograph's Birthday** Edison, phonograph's father, left, shows model of the original on its fiftieth birthday to Gov. Moore of New Jersey



**Vesuvius Busy Again** When Mount Vesuvius recently renewed activity after several years' quiescence, a plucky airplane photographer, at considerable risk, flew above and took this photograph of smoke, ashes and lava issuing from one of the active inner cones that are surrounded by the volcano's crater

# Strange Things But True!



**Light Rivals Sun** This greatest searchlight beacon—for the Boston - New York - Washington - New Orleans air mail route—is of 1,385,000,000 candlepower. In its light, the photograph of Jefferson's home at the right was made



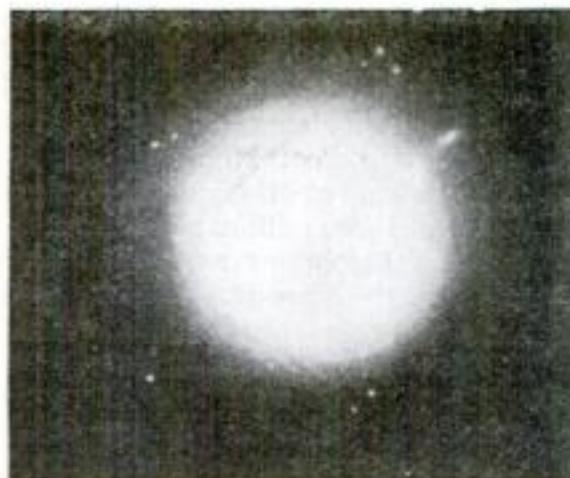
**Leaning Tower's Peril** Experts have just reported the famous Pisa tower in Italy will eventually fall. Its top leans an inch farther out every twenty-five years



**New Rock Borer** Straight into solid rock bores this marvelous new tunneling machine, invented by Oliver O. App, of New York City, which makes blasting unnecessary. Compressed air drives eighteen powerful hammers in its head—500 fifty-ton blows a minute! The inventor is shown watching his machine at work on the construction of New York's latest subway



**Flood a Blessing** These grapes are part of the reward that the devastating flood of last May brought to Carl Graeber, of Lawrence, Kans., shown with them. He had planted vines on a barren sandbar he owned, where nothing else would grow. The waters caused by the flood spread fertile earth on the bar and here is the result



Telescope photograph of a universe, or galaxy, at an early age—a great chaotic mass of glowing gas having the general form of a sphere



An older universe than that at the left. In rotating it has flattened out. It is probably a thousand times as distant as surrounding stars, which are in our universe



A spiral nebula in the Big Dipper, quadrillions of years older than the nebula seen just to the left. This throws stars out into space

# Fix Limits of the Universe

**Astronomers, with Amazing Instruments, Make New Map of Our Vast Star Cluster and Explore Others Beyond**

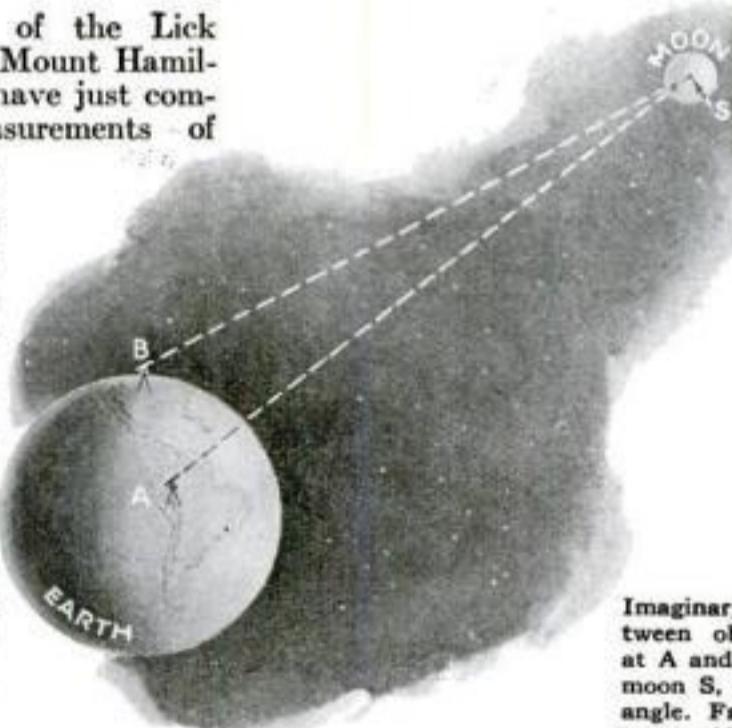
By EDGAR C. WHEELER

**A**STRONOMERS of the Lick Observatory on Mount Hamilton, California, have just completed new measurements of the universe of stars in which we live. Through huge telescopes they have reached to scattered outposts on the borderlands of the Milky Way. There they have caught the faint glimmer of lonely little lamps that are, in reality, great fiery suns, at incredible distances, hurtling through space at speeds that defy imagination. And from the nature of that light they have calculated the distance across the vast swarm of stars in which our sun, with its planets, is an insignificant mote.

This distance, they tell us, is 60,000 light years, or about 350 quadrillion miles.

**S**UCH an appalling figure, of sixteen ciphers, is beyond the grasp of most of us. Imagine an airplane, speeding 200 miles an hour, attempting to cross this star-flecked ocean. It would take about 200 billion years—forty times the age of the earth! Or imagine it were possible to travel with the speed of light—186,000 miles a second. To have completed, at the present moment, the journey across the universe, we must have started 600 centuries ago, before the first primitive man appeared in Europe!

That man, a mere atom in the majestic



Imaginary lines between observatories at A and B and the moon S, form a triangle. From the distance AB the distance AS is computed

pageant of creation, thus should span the universe with yardsticks of science is one of the wonders of modern astronomy. In the last few decades, surveyors of the night skies have steadily advanced their mileposts into the infinite void, aglow with millions upon millions of suns. They have charted long unfathomed mysteries that lie all about our little world. And they have found that what once seemed bewildering chaos, really runs with matchless system and order.

The number of stars which our unaided eyes can see is about seven thousand. Great telescopes reveal many millions. These stars, astronomers find, are not sprinkled at random in space, but grouped in countless separate universes. Our uni-



A universe photographed by telescope in its last stage. This is the Small Magellanic Cloud—one of the nearest nebulae that have been observed by the Harvard Observatory to be composed of myriad small stars. This "decaying" spiral nebula is estimated to be 100,000 light years from the earth

verse, the Milky Way, is one of them, and our sun, a huge ball a million miles in diameter, is just one of a million stars in the swarm.

The latest measurements, the work of Dr. Allan Douglas Maxwell and associates at Mount Hamilton, have been achieved through observations of the frontiers of the Milky Way, where the stars thin out in number and scatter into nothingness. Dr. Maxwell measured the distances of 2,000 of these faintest suns, and from them calculated the distance to the outermost borders of the swarm.

But astronomers, not satisfied with merely knowing the size of our universe, seek now to map its exact form, surveying the exact positions of the million suns that compose it. They have long believed that the shape of our Milky Way cluster is a great disk, like a watch, bulging at the center. They have thought, too, that our sun, with its planets, lies somewhere near the center of the disk. But they have never known.

To find out for certain, the Astronomical Observatory of Harvard College has just undertaken, as this is written, the colossal task of surveying all the stars, one by one, and fixing their exact positions in space. In two or three years, says Dr. Harlow Shapley, director of the

observatory, they expect to complete the vast family picture.

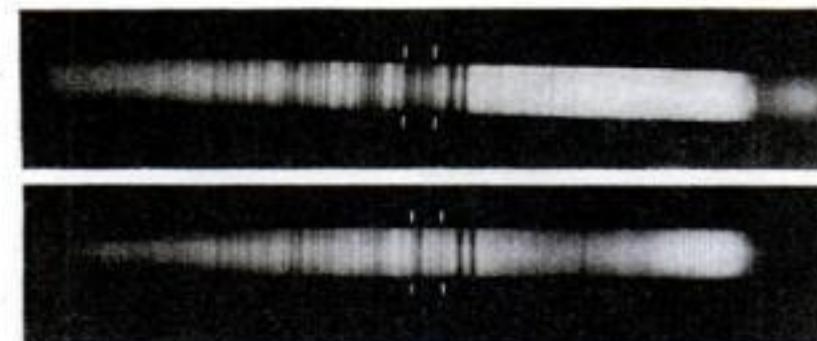
Then what? Well, the heavens are endless as time. Even now the star surveyors have begun to chart the universes beyond—those other swarms called nebulae, some so far distant that their light travels tens and hundreds of millions of years to reach us. We are told that there are probably billions of them—like our own! In them lies the whole fascinating story of creation. The greatest telescopes, like the 100-inch Mount Wilson reflector, have resolved some of them into their tiny specks of suns. Their shape, and something of their age, substance and distance are known. Some are newly born; others, falling to pieces of age. Like ourselves, they have a beginning and an end.

But how, we wonder, is it possible for astronomers to sound these depths of space, and measure inconceivable distances of objects which unaided eyes cannot hope to see?

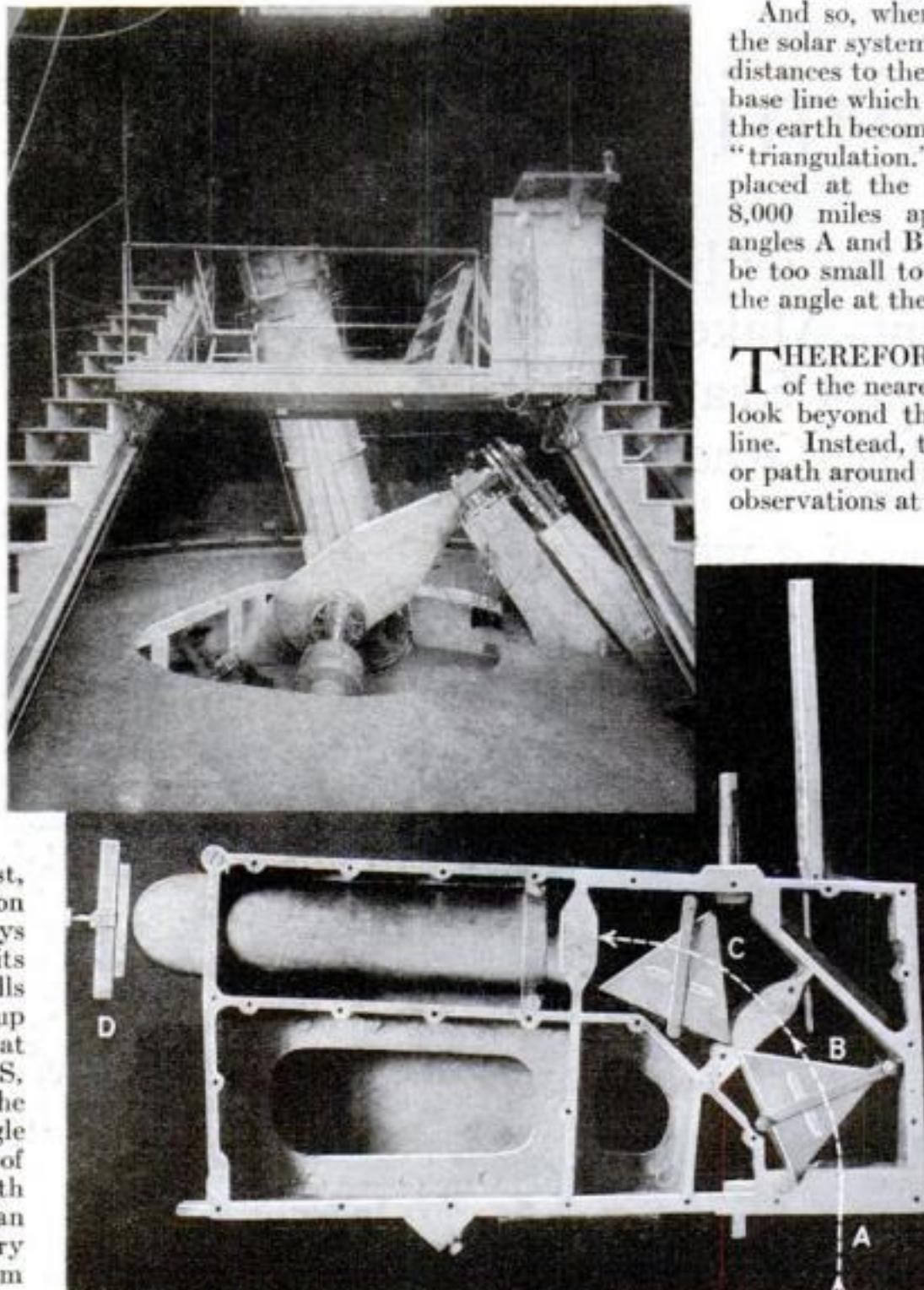
There are a number of ways, some of which are truly amazing.

WHEN it comes to surveying the sun, moon and other planets, the problem is almost as simple as that of a surveyor when he lays out a plot of land. Suppose he wants to measure the distance from a given point, which we will call A, to a point S, on the opposite side of a lake. First, selecting another point, B, on his own side of the lake, he lays out the line AB and measures its length accurately. This he calls his *base line*. Now, setting up his transit, first at A and then at B, each time focusing on S, across the lake, he measures the angles at A and B of the triangle ABS. Knowing the values of these angles, as well as the length of the base line AB, he can quickly calculate by elementary trigonometry the distance from A to S.

Of course, the farther point S is from the base line, the smaller will be the angle at S, and the nearer will the angles at A and B approach right angles. Thus, the measurement to distant objects, such as the sun and planets, requires a much longer base line than for objects close by, in order to make the angles calculable. So, when surveyors of astronomy measure the distance to the moon, say, they select for stations A and B two observatories far removed from each other on the earth's surface; one, for example, in North America, the other, in South America. This separation gives angles at A and B that are measurable. In all other respects their problem is identical with that of the earth surveyor, and their



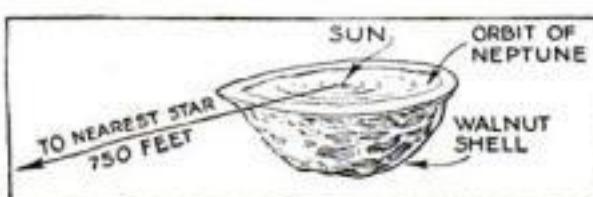
Photographs of the spectra of two stars, taken with a spectrograph fitted on the Crossley reflector at Lick Observatory. The dark band near the middle of each indicates a carbon-nitrogen compound. This compound is decomposed by high pressure, so it is known that the star containing the most of it is the less dense. Knowledge of the density of a star aids the astronomer in computing its distance



Photographic diagram of quartz spectrograph. Light entering at A is bent by prisms B and C, which break it up into rainbow colors. It comes to focus on photographic plate, D, on which is recorded the spectrum of the object photographed. Above is shown the reflector of Lick Observatory, to which the spectrograph was attached

computed distance to the moon is just as accurate as measurement of earth distances.

In our solar system the distances are more or less comprehensible to most of us



If infinity were reduced in size so that our solar system would go into a walnut shell, the nearest star would be 750 feet away from the sun

—the sun, a ball a little less than a million miles in diameter with its eight planets; the earth, with its moon distant a quarter of a million miles; Neptune, on the outskirts of the solar system, about three million miles from the sun. Enormous as these figures seem, they are insignificant compared with the distances to the stars. Suppose the sun and planets could be shrunk to fit into a walnut shell, with the sun at the center. Even on this small scale, the nearest star (actually 26,000,000,000 miles away) would be 750 feet distant from the shell!

And so, when astronomers go beyond the solar system and attempt to calculate distances to the nearest stars, the longest base line which can be laid on the face of the earth becomes altogether too small for "triangulation." Even if telescopes were placed at the North and South Poles, 8,000 miles apart, the deviations of angles A and B from a right angle would be too small to be calculated. So would the angle at the star, S.

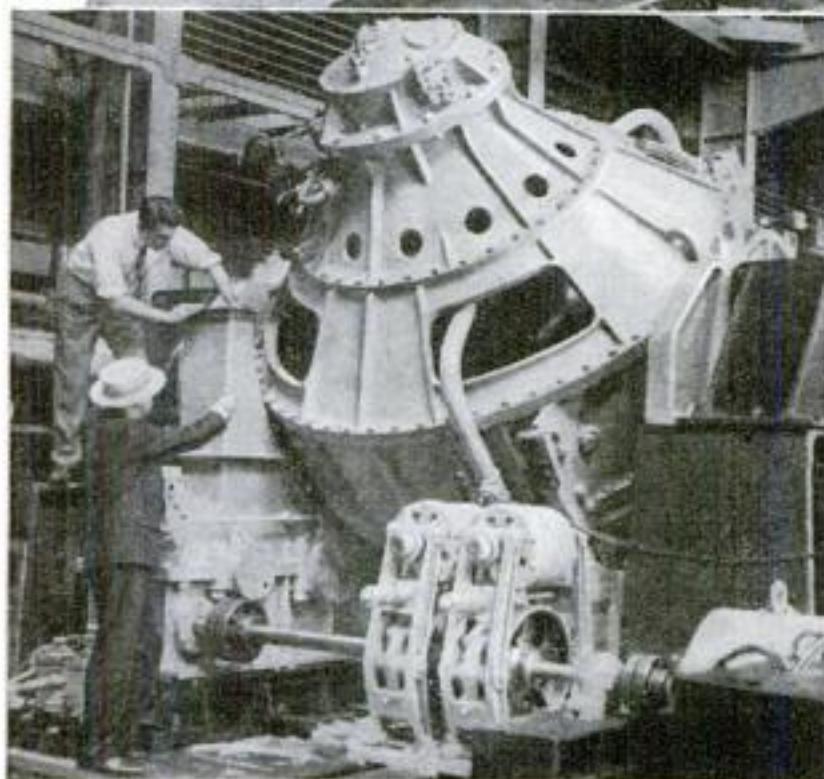
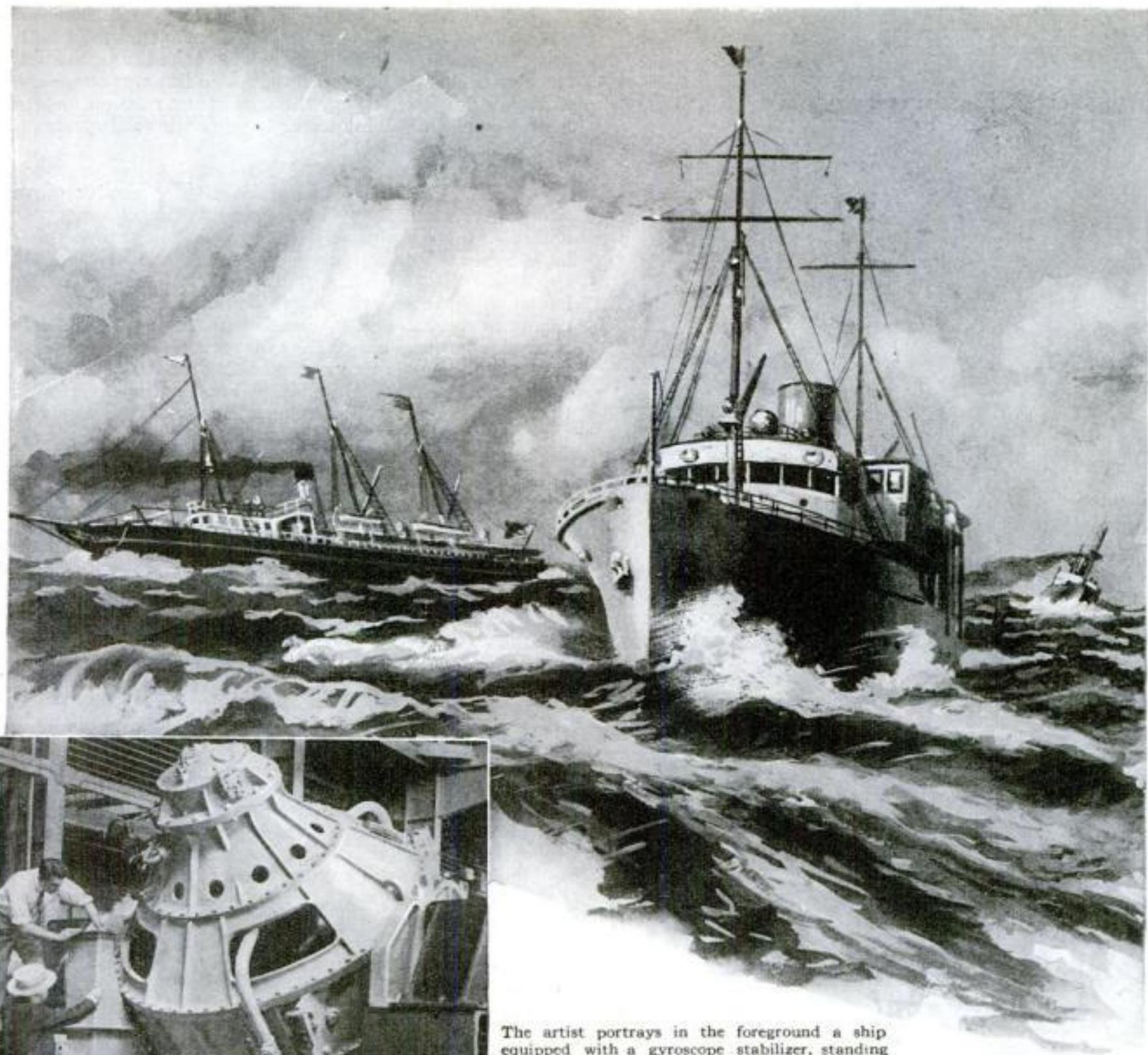
THEREFORE, in measuring even one of the nearer stars, they are forced to look beyond the earth itself for a base line. Instead, they use the earth's orbit, or path around the sun! They make their observations at intervals during the year,

at successive positions in the earth's circular path. Thus, for observations at opposite sides of the orbit—observations six months apart—the possible separation, or base line, is 186,000,000 miles, twice the distance from the earth to the sun.

Yet even this immense separation requires almost unbelievably fine measurement of angles. To realize the precision required to survey the *nearest* star, hold a copper cent, face outward, in your hand. Think of its circumference as representing the earth's orbit, and its diameter as the base line AB of the triangle in which the point S, representing the star, is a pin point a mile

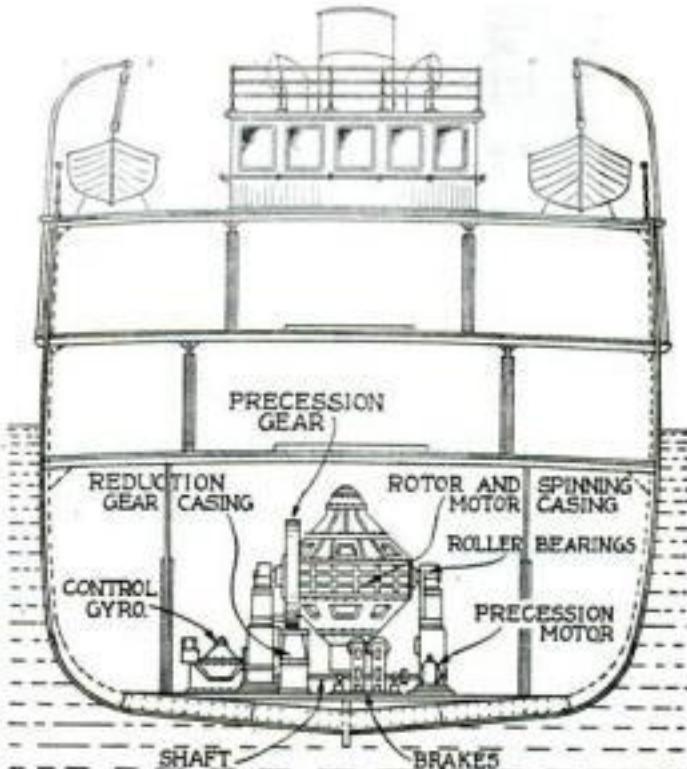
and a half away. Then try to calculate the angle at that pin point. Yet it is this very angle which astronomers observe. Indeed, with the enormously powerful telescopes at their command, they are able to calculate angles a hundred times smaller than this!

When we try to think of the distance of this nearest star (26,000,000,000 miles), the long string of twelve ciphers is beyond comprehension. And the numbers become even more meaningless as we advance farther out into space. Here astronomers solve the difficulty by employing a new (Continued on page 174)



The artist portrays in the foreground a ship equipped with a gyroscope stabilizer, standing like a rock in the storm that rolls the distant craft

The spinning horizontal wheel inside the huge steel casing, shown in the photograph at left, resists and halts the roll of the ship caused by the waves



The spinning gyroscope, controlled by a smaller one and a precession motor, reacts to the wave action, keeping the vessel on even keel

## An Unrockable Ship

**C**OMFORT and ease of navigation are assured Mrs. Richard M. Cadwalader, of Philadelphia, owner of a \$2,000,000 294-foot yacht, by the largest gyroscope ever built for yacht service, announced in the July POPULAR SCIENCE MONTHLY. According to the makers, its whirling wheel—weighing twenty-five tons—will keep the vessel steadily upright in the roughest of seas, while other craft roll and toss.

Through a small control gyro, brains of the outfit, the huge wheel, constantly spinning at high speed, reacts just enough to every wave to keep the ship on even keel. At will, however, in a calm sea, the ship may be rocked sideways by manipulating the small control device to free

itself from sand and mud, or to open a lane through ice fields.

Curiously enough, when a spinning gyroscope is tipped on its side, as by a careening ship, it tilts fore or aft—or “precesses”—and at the same time vigorously opposes the sideways tipping. This alone keeps a ship on fairly even keel, though the action is a little sluggish. In this outfit the small control gyro reacts to an oncoming wave in one quarter of a second. Through an electric “precession motor” and gear it gives the main wheel a shove that helps quickly to set up a counter sideways force, neutralizing the wave’s effect.

Brakes slow the massive wheel’s tip-

ping and safety buffers stop it and shut off the motor that spins it, should it swing too far from upright. If the whirling gyroscope should heel over clear on its side it would turn the vessel in circles.



Back in the lines Beezo was calling that the general was in a stew because he could not communicate with the 55th

# Contact!

With his crude little radio set he helped save a regiment from disaster—A story of a signal man's skill and valor under fire

By ARMSTRONG PERRY

Illustrated by Harry Townsend

**A**SHELL came whining over from the enemy's line. Burden ducked. The action had become as instinctive as that of a civilian dodging an auto. His ears knew, whenever they heard a shell, whether it was headed for him or would strike at a safe distance.

He flattened himself in the shallow trench, protecting his breast reel and service buzzer and pack, as well as his person.

*Pow!*

The earth trembled. A red glare and the whistle of shrapnel. One piece glanced from his helmet with a sharp *zin-n-n-g!*

Burden half sat up again and went on splicing his wire. No use looking into the darkness. All he could see there were the flashes from enemy guns, and flashes did not count. His ears could stand guard; ears develop keenness in the Signal Corps.

The flashes were not directly in front. In that direction, a kilometer away, was the 55th, from his own division. Whenever he thought of that outfit his lips automatically framed the expletive, "Fools!" Why had the 55th upset a carefully planned offensive? Why, in order to give the papers back home another chance to extoll the 55th's impetuous, irresistible fighting, had they lost sight of something equally important—coöordination with the rest of the army?

Why had they thrown their brains along with their packs and coats when they went over the top at zero that morning? Their orders had been definite; they were to take the German first-line trenches and stay there until the Allied line was consolidated for a further advance. Why, then, did they rush on and take the little wooded hill a kilometer beyond where they should have stopped?

**B**URDEN had his own opinions. The shelter of woods—shelter of any kind—looks good. It takes less nerve to go on and capture such a place while you are going, than to stop and let the enemy retain a temporary advantage. But by this time the 55th realized what it meant to be ahead of the line, with flanks unprotected, with a gap behind them wide open for the enemy to come in and surround them, and with no communication. Anyhow, he hoped they had sense enough to realize their fix, and the trouble they were making for the Signal Corps.

Burden crawled on through mud and darkness. He was SOL, that was all; for to him had fallen the job of connecting them up with headquarters. And it was a rotten job.

*Zzzzzzzzzz—Pow!*

That proved it. The shell struck a hundred yards behind him. He tried to call Beezo. Good old Beezo! He would answer if there was any way to get a connection. But there wasn't! Whether the German gunners knew it or not, they were making a mess of his wire. Burden crawled back into the sulphurous, choking cloud of smoke and dust. There was a yawning crater where he had found but a shallow trench before. He yanked at the broken wire until he brought out one end from under the earth heaped upon it. He crawled through the shell hole with that, found the other end, spliced and taped them together.

He called. Beezo answered. Beezo said the general was in a hurry to get into communication with the 55th. That was no news to Burden.

A star shell threw a brilliant flood of light about him. Heinie wanted to see what was going on. Burden froze, just as he was. Shapes, even human shapes, may be overlooked or mistaken, but motion attracts the eye. The light died and nothing happened. Either they had not seen him or they planned to wait and find out where he was going before trying to get him.

He slithered back along the muddy trench, laying and covering his line. He reached a communication trench and paused on the edge for a moment, listening for signs of life. There were none. The Germans were out of the trench and the 55th had left no one behind to hold it.

He slid down into the ooze. It was a relief to be safely below the surface. He called Beezo. Beezo was glad he was in a more sheltered position. He said the general was asking if Burden couldn't hurry that wire so he could give the 55th its orders.

*Pow!*

He hadn't heard that one coming. The line was dead again. Muttering his disgust, he crawled out of the trench and back along the wire, found the break, spliced it and reported to Beezo. Then he wormed his way back to the trench.

He groped ahead, the wire unwinding from his breast reel. His foot struck something. It was the dead body of a German. He straightened it out, laid the wire along beside it, and rolled it over onto the wire.

"You gotta work, Heinie," he muttered. "Can't get out of it just by being dead. Hold that wire down and don't let anything happen to it!"

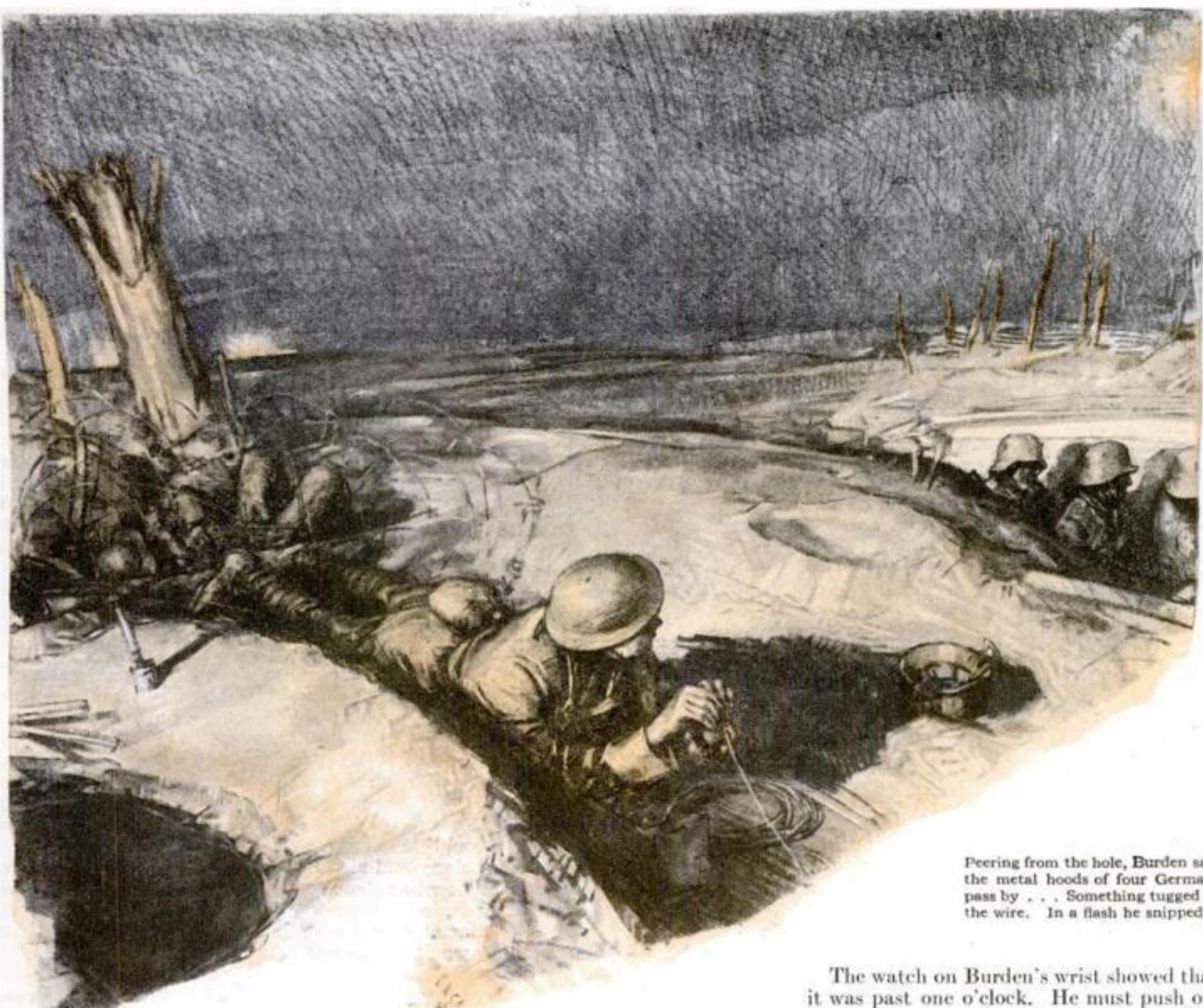
He stumbled over another body. It groaned. Burden put his canteen to the German's lips. No response—unconscious. He placed him in as comfortable a position as possible and went on, laying the wire.

**R**AIN began to fall. It always rained in France! The air was dank and foul. He estimated his distances by the number of paces he took and by the lightening of his reel as the trail of wire behind him lengthened. One hundred yards—another hundred. It was tiresome work. He paused long enough to sip from his canteen. Not too much, for there was no telling when he might get out from between the lines.

Now and then he peered over the edge of the trench into the drizzling darkness. Ahead, the outline of the hill was dimly visible against the sky. German shells were dropping upon it methodically. The 55th was not replying because it had no artillery.

He went on. Where a communication trench joined a cover trench he almost bumped into a scouting party. He sank into a dugout, just in time.

Peering up from the hole he saw heads pass between him



Peering from the hole, Burden saw the metal hoods of four Germans pass by . . . Something tugged at the wire. In a flash he snipped it

and the leaden sky—one, two, three, four—that was all. The helmets were not the flat, flaring tin hats of the Allies, but the great metal hoods of the Germans. The soldiers paused and whispered. He could not make out what they were saying.

Burden touched the gun in his holster, but he knew better than to use it. He was not there to kill Germans but to string wires. The Signal Corps cannot stop to fight except when it must fight to go on with its work. He smiled grimly as he thought of what he would get if he left his wire and took those scouts prisoners, or shot them at the risk of attracting others who might rush in and discover that vital line of wire.

**WITHOUT** communication, an army would be like a hen with its head cut off, behaving crazily, weakening rapidly and dying soon. That was what the 55th had overlooked—fools! Had they imagined that the Signal Corps would tag along behind them when they cut loose from the rest of the line?

Something tugged at the wire in his hands. Quick as a flash he snipped it with his side cutters, covering the tool with his hand to smother the click. Either the scouts had caught their feet in the wire or had picked it up and were pulling on it. Probably the former, for soldiers do not pull on wires in abandoned trenches without knowing what they are hitched to—too often there are mines at the end, ready to explode and blow them into kingdom come. Anyhow, he wanted them to satisfy their curiosity about that wire without further investigation. He darkened the fresh cut with a smear of mud, to make it look like old wire.

In a moment they went on. When they were safely out of the way, he connected up again and tested. Beezo was there, and glad to know that he succeeded in evading the enemy and was a little farther along. He said the general was in a great stew—couldn't Burden reach the 55th soon?

The watch on Burden's wrist showed that it was past one o'clock. He must push on, for at zero something must happen. Probably the line would move up, per schedule, clearing out any Germans that might have worked in around the flanks and rear of the 55th to a position where they could not be shelled without danger of hitting that fool organization. Maybe the 55th would have sense enough to wait. Or would they go on and try to win the war all by themselves! Anyhow, he had to put them in communication with headquarters.

**T**HE communication trench went through a culvert under a road. Above him, on the road, he dimly discerned a battered shape that might be a disabled truck. He climbed up to it—it was.

He felt over the dash. The spark coil was there. He short-circuited a pair of wires; there was a buzz from a spark plug inside the engine.

He wrenched the coil box loose, and placed it on the ground, then from under the seat he extracted the battery. Heavy as it was, he toted it back into the trench, and along the trench for a quarter of a kilometer as he laid his wire.

Then he talked with Beezo. Amid the thunder of the shells, it was hard to understand what Beezo was saying, but he gathered that the general, on receiving the report about the German scouts, ordered that Burden must reach the 55th before the scouts returned and reported. Burden told Beezo about the battery and coil, but suggested that they keep it a secret, just between themselves. The general was in such a hurry that he might object to Burden's carrying so much extra equipment!

*Pow!*

That shell was hundreds of yards back, but it cut the wire and stopped their conversation. There was nothing to do but go back again. Maybe he ought to have had one of the boys to take care of that section of the line, but there were not many left. Six of the best had gone west that morning, about the time the 55th broke loose. Replacements always went to some other



outfit. The Signal Corps men were not fighters! They wore side arms but never used them! How could they get hurt? Why should they need replacements? That was what the K.O.'s seemed to think.

Burden was covering more than a kilometer, not because one man was enough but because every other man had as much and equally important work elsewhere. He had not slept for two nights and a day, but that was a mere detail. Heinie, back there holding the wire down, had to keep on working even after he was dead.

Just as Burden's soliloquy reached that point his physical self arrived at the spot where he had rolled the dead German onto his wire. Heinie had played him a trick. He had parted in the middle and let a heavy fragment of a shell go right through him and cut the wire. Burden took the wire away from him, and bawled him out noiselessly but vigorously.

The wire spliced and covered, he made his way back and pushed on toward the 55th. By half past two the hill was much closer. He was glad of that, for his pack, breast reel, service buzzer, battery and spark coil, individually and collectively, began to weigh a ton. He was glad the general could not see him lugging that battery; he might not understand. Not being a signal corps man, the general, of course, would not understand how impossible it was for a man responsible for maintaining communication to pass anything containing juice and not take it along with him.

He called Beezo. Beezo told him that zero was 4:15. The general was greatly agitated because he could not communicate with the 55th. He could not understand why it took Burden so long to reel out a kilometer of wire. Beezo got that much across—and then, hell broke loose!

SHELL fire was not new to Burden. It had lost its novelty months before. But what was happening now was worth stopping to look at, if there had been time. Evidently the German scouts had reported the unprotected flanks of the 55th, or perhaps division headquarters had decided to mess up no-man's-land on general principles. They seemed to be turning everything they had on the terrain that he had just crossed with such infinite toil. In fifteen minutes he realized there was enough splicing to be done to keep all the Signal Corps men on a division front busy for a day. He might as well have stayed in a dugout behind the lines and enjoyed a good night's sleep, for

Stringing an aerial wire like a clothesline between the butts of two rifles stuck in the ground, Burden hooked up his little radio outfit. "Ready, sir!" he said. Word by word he hammered out the commander's message, then he listened

all the good his work had accomplished.

He half carried, half dragged his battery and spark coil along the trenches toward the hill, trying to keep his head low enough to escape any flying missile. He wished that his grandmother, who used to tell him that he made so much noise she could not hear herself think, could hear just a small sample of the infernal racket!

*Pow-wow-wow-wow!*

He wasn't quite quick enough that time. His tin hat was leaking. Maybe it was rain water, maybe blood. No matter, he could still walk. Maybe the dizziness was due to hard work and loss of sleep. He staggered on with his battery and spark coil, his pack and breast reel and service buzzer.

He was close to the foot of the hill now. The shells were falling more to the left and right, not so much around him. Should he make a dash for it? No, it wouldn't be polite to walk in on the 55th unannounced. Maybe they were a bit jumpy by now; they might mistake him for a German.

As a preliminary salutation, he elevated his helmet on a stick. Was it light enough so they could see it?

*Ping!*

Two new holes in it—one where the bullet went in and the other where it went out. They could see, but not well enough!

The hill seemed to be hopping around, the shells were dropping in such large sizes and such liberal quantities. In the uncertain glare from the explosions he could see trees falling, others flying

upward. Would there be any trees or hill left by zero? Would there ever be any real air to breathe again, or must he always inhale the suffocating stench of the trenches and the acrid fumes of burning powder?

Burden started to take off his shirt to wave at the 55th. Maybe they would recognize an American shirt. Something had to be done or they would be heaving grenades at him.

He paused, for he heard, in a second when no explosion deafened him, a slight sound of moving bodies. Or did he feel the vibration as he leaned with his hands on the edge of the trench?

"HOWDY!" he called, quickly, before any visitor could do anything he ought not to.

*Pow!*

A shell exploded fifty yards to his left and two doughboys dropped in right on top of him. Maybe the shrapnel helped them.

"Here, you kyote, grab one handle of that battery—and you, Bo, carry this spark coil!" Burden commanded. Without argument, the boys from the 55th obeyed.

They galloped across the few yards to the trenches protecting the 55th's front, or rear, or whatever it might become in the action that must take place within an hour. Inside the lines Burden was led to the commanding officer.

"Can you get us in communication?" snapped the K. O.

"That's what I'm here for, sir!" Burden admitted.

"Got your wires across and working?"

"Had 'em, sir, up to the time the rumpus started out there—all gone now, sir!"

"Then what can you do?"

"Show me where you want your communication headquarters and I'll put it there, sir."

The commander led the way. The soldiers with the battery and coil followed them. The spot was pointed out.

Burden asked for two rifles, fixed the bayonets and drove them into the ground a hundred yards apart, leaving the butts of the guns sticking up in the air. Then he strung a wire from one to the other, like a clothesline between two poles. He worked mainly by sense of touch, for it was not wise to show a light.

He connected his spark coil and battery at the middle of the wire, and hooked up his service buzzer so that he could use its sending key.

From his pack he took a little radio

*(Continued on page 156)*

# Who Did the Shooting?

*New scientific methods "fingerprint" bullets and firearms—What Sacco's pistol told me*

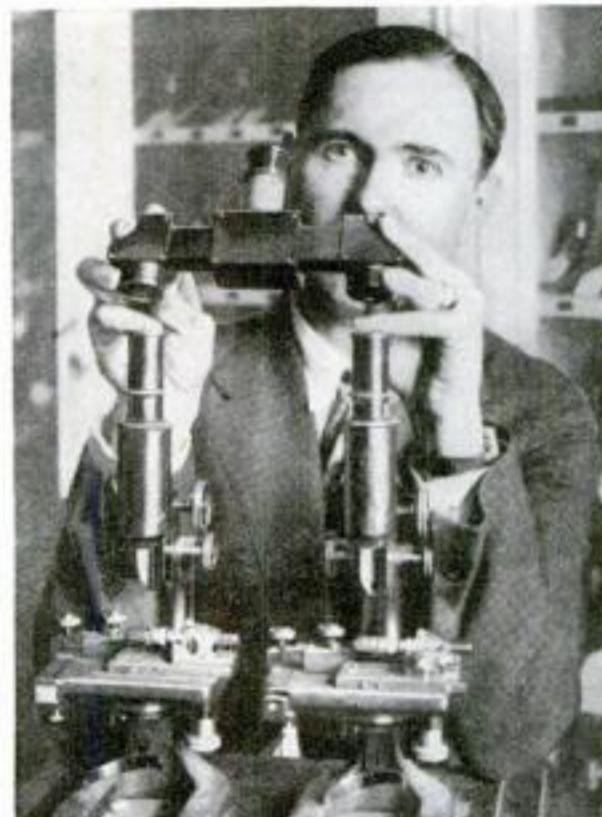
By CALVIN H. GODDARD

**I**N A county in western New York a man was found guilty of a double murder on the opinion of a firearms "expert" that the bullets removed from the bodies had issued from the defendant's revolver. The case aroused the interest of Charles E. Waite, a lifelong criminal investigator, then attached to the office of the State Attorney General. He proved the bullets could not possibly have come from the weapon in question, established the innocence of the convicted man and secured his pardon, and brought about the arrest of the actual murderers.

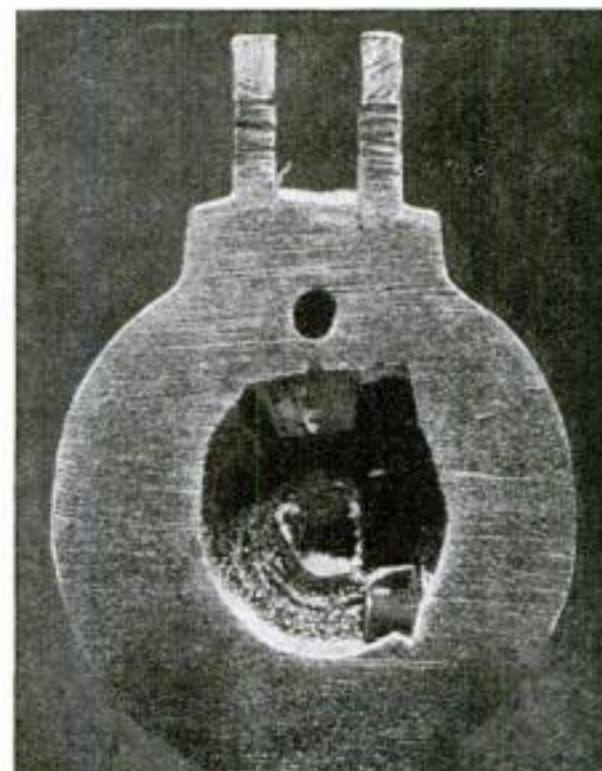
From that time, twelve years ago, Waite devoted his life to establishing a system of bullet and firearm identification which would require no "opinion" of experts to substantiate it. It was to deal with facts, and facts alone. In ten years he visited every pistol and revolver factory in America, and many in Europe, gathering a mass of data about weapons and their manufacture. Later he and I joined forces, adding as associates Philip O. Gravelle, a master of photography, and John H. Fisher, an expert in micro-metrics. Since the death of Mr. Waite last year, I have continued the work.

**T**ODAY the result of our efforts is a new science of identifying weapons—a science as exact and conclusive as that of tracing criminals by their fingerprints founded on the revelations of the microscope and precision measurements within the ten thousandth of an inch.

This science bears the rather high-sounding name of "forensic ballistics." Actually, though, it is simplicity itself. Like the fingerprint system, it is based on the fact that no two things ever are exactly alike. A bullet fired through a pistol, revolver or rifle invariably bears certain distinctive marks or scratches—the "fingerprint" of that particular weapon's barrel. Even bullets fired from two weapons of exactly the same make and type and made by the same machines and tools, bear characteristic imprints which even untrained eyes can distinguish under the microscope. Moreover, the shell from which a bullet is fired also bears individual marks made by the firing pin and breech-block of the weapon. We have developed scientific methods of employing these



Opposite halves of bullets under these two microscopes are brought together in the cross-arm eyepiece held by Major Goddard. If their markings match, both of the bullets must have been fired from the same gun



Microscopic photograph of the breechblock of a revolver, against which the base of a shell strikes when fired. The scratches around the small firing pin hole are imprinted by the impact in the shell base

At the right is a microscopic photograph of a fired shell picked up at the murder scene; at the left, one of test shells fired from Sacco's pistol. Observe the similarity of V-shaped and other scratches on both



marks to trace a bullet or shell to the weapon from which it came; and of proving whether a certain bullet could possibly have been fired from a given weapon.

Perhaps I can best give an idea of these methods by describing briefly my recent tests of the bullets, shells and pistol in evidence in the famous Sacco-Vanzetti murder case, in which Nicola Sacco and Bartolomeo Vanzetti were put to death for the murder of a factory paymaster and his guard at South Braintree, Mass., in 1920. While the appeal from the sentence was under consideration by Governor Fuller last summer, I offered to make the tests. The pistol in question was a .32 caliber Colt automatic; Sacco had admitted its possession. While the prosecution and its experts had contended that at least one of six bullets from the bodies of the murdered men had issued from that weapon, the defense with equal vigor had denied this contention. My sole purpose, in the interest of justice, was to establish the truth of the matter by the unbiased evidence of science. The offer was made first to the defense, which declined it; then to the prosecution, which accepted. Entirely irrespective of the guilt or innocence of the defendants, or whether they received fair trial, the tests established beyond contradiction these two long-disputed points:

**F**IRST, that the so-called fatal bullet, No. 3, one of four from the body of Berardelli, the paymaster's guard, was fired through the Colt automatic subsequently found in the possession of Sacco and could have been fired through none other.

Second, one of the six shells picked up at the scene of the murder and known as "Fraher shell No. 3," was fired in Sacco's pistol, and could have been fired in none other.

Those facts were revealed by the microscope so clearly that any layman might see them for himself, and so convincingly that an expert for the defense, in my presence, agreed in astonishment that they were beyond dispute.

In the Court House at Dedham, Mass., I conducted the tests in the presence of a professor in the Massachusetts Institute of Technology, who was an expert representing the defense; the Assistant District Attorney in

charge of the case, a member of defense counsel, the Clerk of the Court, a stenographer and four newspaper men.

First I explained why every weapon leaves its own distinctive imprint on the projectiles it fires. In making a pistol or rifle barrel, the first step is to bore a hole through a cylindrical steel bar. Then a reamer smooths the rough inner surface. Next comes "rifling"—cutting a series of extremely shallow grooves, running spirally through the length of the barrel, to impart a spin to the bullet as it passes through. The surfaces between the grooves are known as the "lands." The grooves vary in different makes of weapons. In some there are five, for example; in others, six. In some they are arranged to give a right-hand twist; in others, left-hand.

**I**N THE barrel of the Sacco pistol, there are six grooves, with left-hand twist. Each spiral makes one turn in sixteen inches. The depth of the grooves is .0035 of an inch; their width, .108 of an inch; the width of each land is .051 of an inch.

Now, the marks by which any bullet may be identified are due largely to the tool called the rifling cutter, which cuts the grooves. To the unaided eye the sharp edge of this tool appears perfectly even; but actually, as in the case of a razor, the edge consists of a row of minute saw teeth, visible only under the microscope. These teeth leave microscopic scratches and ridges on the inner surface of the barrel. And when a bullet is fired through, these irregularities are impressed upon it in the form of very fine lines running parallel to the deeper lines cut by the groove edges.

Since no two rifling cutters can have little saw teeth exactly alike, no two pistol barrels can have exactly the same markings. Moreover, the edge of a cutter changes with every cut; hence, even if two barrels are rifled on the same machine and with the same tool, the markings they leave on bullets will differ.

A similar thing happens in the case of the breechblock and firing pin of a pistol. In filing down the breechblock the file invariably leaves distinctive scratches, which are never the same on any two arms. Later, when a bullet is fired, and the shell is hurled back against the breech with a force of some 10,000 pounds pressure to the square inch, the breech acts as a steel die, impressing its file pattern indelibly on the copper primer or cap of the shell. Thus the breech of every gun leaves its own distinct pattern.

Moreover, no two firing pins are ever the same in contour, even if made on the same machine. Conse-

quently the dent made by the firing pin of a certain gun on the primer of a shell is an identity mark for that gun and no other.

In short, every weapon in the world leaves its individual telltale fingerprints on every bullet and shell it fires.

In the Sacco-Vanzetti case there were four bullets from the body of Berardelli,

a comparison microscope, invented by Philip O. Gravelle. This is really two microscopes in one, fitted with prisms so arranged that when two objects are placed beneath, the left half of one and the right half of the other are centered in the single eyepiece. This has the effect of fusing the opposite sides of the two objects into a single image. The extent to which the two halves match is a measure of the similarity of the objects.

First I examined the shells. Under the microscope I placed one of the murder shells and one of the test shells, with the caps facing upward. Examination quickly showed that they could not have come from the same weapon, for the imprint of the firing pin was entirely different in the two halves. The substitution of a different test shell brought the same result.

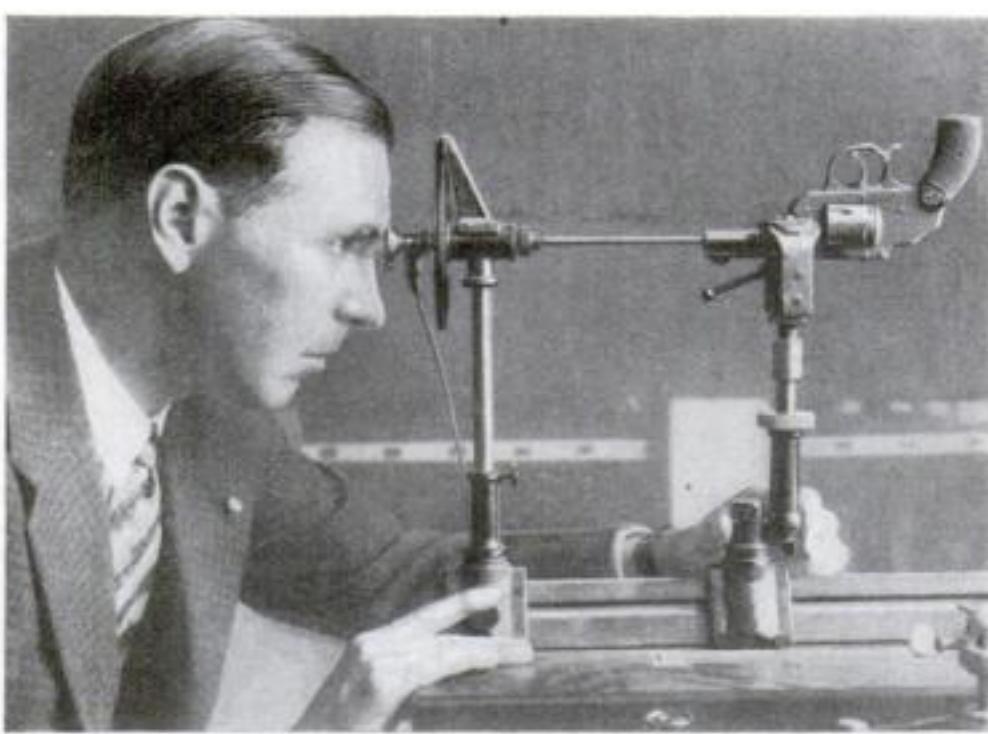
**N**EXT I tried a second murder shell. This likewise was decidedly different from the test shell, both in the imprint of the firing pin and in the absence of certain ridges which appeared across the cap of the test shell. It was impossible to match the two halves.

But the third murder shell matched perfectly with the one known to have been fired from Sacco's automatic. There was no question that the two came out of the same gun. The firing pin imprints were of exactly the same diameter, and the markings imprinted by the breech-block were identical. Holding one of the shells stationary, I carefully turned the other until both were in the same phase,—that is, until the features of the opposite halves matched at the center line. The imprints—scratches and ridges—matched all the way across the face of the shell.

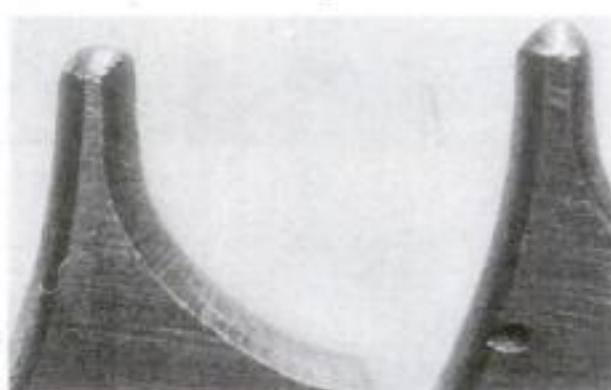
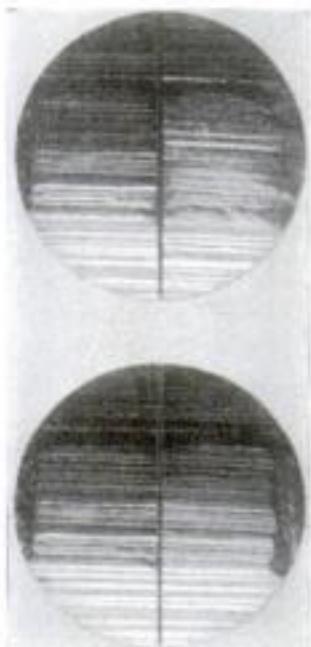
The identity of these "fingerprints" is revealed in the microscopic photographs of the two shells reproduced on page 21. At the right is the murder shell in evidence; at the left is the test shell fired in the Sacco pistol. If you look closely you will see the similarity of little V-shaped

scratches on both primers. Then if you compare the other scratches and ridges you will see that in every case they are of the same dimensions and in the same relative positions. The identity is equally clear in the imprints of the firing pin at the center, even though the test shell at the right bears the additional imprint of the trade mark "W." Observe especially the deep setback or indentation at the left of the firing pin imprint in each case.

You will see, of course, that neither the firing pin marks nor the imprints of the breechblock as a whole are in exactly the same relative (Continued on page 171)



Calvin H. Goddard, ballistic expert, studying and measuring grooves and other markings in a revolver barrel by means of the helixometer, a tiny microscope and delicate precision measuring instrument combined in a single device



Microscopic photograph of two revolver firing pins, made as nearly alike as possible, one after the other on same machine. Note differences in their contours that unaided eye could not see

At left: Halves of two bullets from the same pistol, brought together by comparison microscope, in lower photo. Note how they match. Above, unmatched halves from different guns



The inside of a rifle barrel under the microscope, showing the rifling, or spiral grooves, which can never be exactly the same in any two weapons

the guard, and two from that of Parmenter, the paymaster. In the tests at Dedham the Berardelli bullets were the only ones in question. In addition there were six shells picked up at the scene of the murders. And, for comparison, a number of test bullets and shells subsequently fired from the Sacco pistol by representatives of both prosecution and defense.

By comparing the murder bullets, one by one, with the test bullets, my object was to establish whether any of the former came from Sacco's weapon, and if so, which one or ones.

For this I used an instrument called

# Laboratory May Produce Life

*Eminent Scientist Looks to Chemistry to Create Living Organisms—First Steps Already Taken*

*Oliver Lodge*

By SIR OLIVER LODGE

NOT many years ago the idea that men might ever succeed in duplicating the substance of living creatures was regarded as entirely fanciful and impossible. Yet today many of the organic compounds found in living organisms, such as urea, starch, sugar and numerous others, actually have been manufactured by chemists in the laboratory. Such a thing as the synthetic production of materials that go into the structure of our bodies turns out to be quite possible with adequate skill and knowledge.

"Why, then," we may ask, "cannot chemists or physicists go a step farther and produce life itself?"

Far from denying that such an achievement of creation is possible, I should say it is probable. Indeed, students of organic chemistry, and biochemists who study the foundation material of life which we call protoplasm, tell us today that if we could contrive in the laboratory to extend the manufacture of organic compounds until we had a mass of protoplasm, and were able to subject it to suitable treatment, they would expect it to show vitality and to manifest one or another of the lower forms of life!

From some points of view I regard that proposition as not only reasonable but probable. The reasons are plain. It is an undoubted fact that our planet was once a mass of molten material, or even glowing gas, in which life as we know it was impossible. Yet we know that living things have appeared on this planet. Hence we must assume that something of the kind must have gone on in the past—some first appearance of life in suitably prepared material or protoplasm. And what has gone on in the past may be going on in the present, and may, conceivably, be better understood, and even controlled by man in the future.

BEFORE men can hope to achieve that and many another surprising aim, however, we must vastly increase our knowledge and understanding of the

marvel of life and its relation to the inanimate substances we call matter.

Consider first the lower forms of life. A seed, or every life cell, it appears, is itself composed of an enormous number of atoms. Each of these atoms is now known to be a set of minute electrical

vitality. Within it is an elusive something which not only enables it to build up the structure from alien material, but controls that material in such a way as to erect a structure of definite form and specific type—much as a human builder might erect an imposing cathedral of a definite type of architecture.

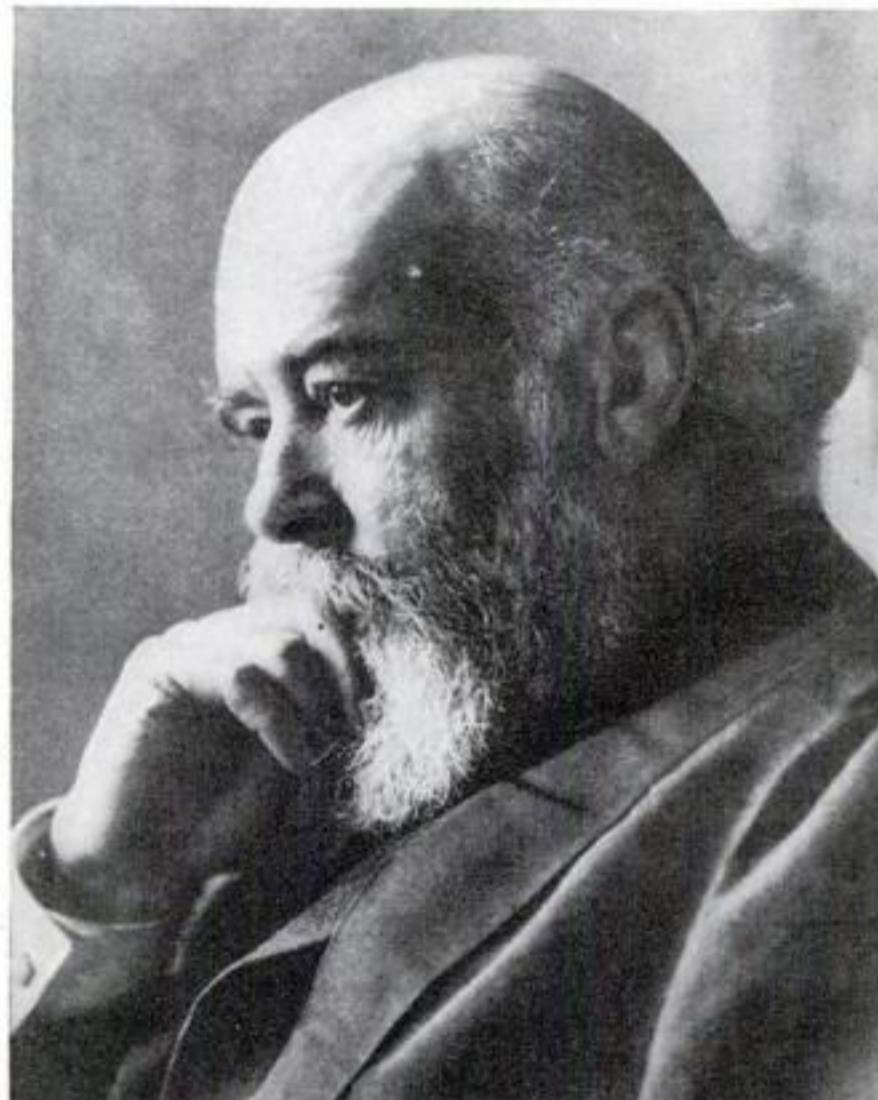
What this type shall be depends not at all on the material substances composing it, but entirely on the indwelling vitality, of which the material is only the vehicle.

IT IS easy enough to destroy this manifestation of life, or vitality. We know today how to aid it to flourish, or how to retard it. But we have no other control over it, and no real understanding. The essence of life is beyond us: we know not whence it comes, nor whither it goes. So far as our present knowledge goes, there is no life without previous life, passed on from one organism to another.

To realize how truly marvelous is this action of life, we need only observe the living objects all about us. Within a single acorn, for example, lies the power to produce a whole forest of oaks. A bird's egg kept warm for a few weeks, though at first apparently a mere mass of unformed protoplasmic material, can result in a fledged creature, with bones, muscles, nervous system and eyes—which can emerge and fend for itself, stand and peck

with discrimination, though perhaps hatched out in a mere incubator. And even the movements of the lowly protozoan, or the amoeba, as it crawls and absorbs nutriment and grows and subdivides and multiplies, is more than anything we are able to account for in terms of the properties of matter.

WHEN we come to the higher forms of life, and particularly to man himself, the marvel of vitality grows. For here we come to the manifestation of mind. I see no radical distinction between life and mind, though mind is conscious of itself, and life presumably for the most part is not. I regard life as the rudiment of *(Continued on page 154)*



Sir Oliver Lodge, venerable English physicist, who writes that production of forms of life by man is not only probable but inevitable

particles revolving around an electrical nucleus. They have grouped themselves into molecules of such complexity as to form the substance we know as protoplasm.

Now, if we interfere with this protoplasm drastically it may show no signs of life. But if, on the other hand, we preserve it intact, the seed will germinate and bud, gathering molecules and energy from the rest of the material world until it builds up the elaborate and perhaps beautiful structure of a plant or an animal. Equally marvelous, it can continue the same process through generation after generation without limit.

And yet no amount of examination of the seed or germ will reveal or explain its

# A Third Degree for Autos

How your car is put through ingenious tests in a 1245-acre laboratory to insure service on any road, in any climate, in any season

By FAY LEONE FAUROTE

**O**N A 1245-acre tract forty miles northwest of Detroit I witnessed, the other day, a mechanical contest as grueling, and in some respects, as thrilling as any of the recent spectacular flights over the Atlantic and Pacific. It was a long-distance contest among the motor cars of the world, for supremacy in speed, durability, power, comfort and safety.

I saw a bright blue sedan, fresh from the factory and polished like a mirror, clinging at breathless speed to the rim of a banked speedway. I watched a mud-spattered roadster crawl up a cliff like a fly up a window pane. I gasped as a seven-passenger limousine dashed at full speed down a strip of slithering wet concrete and skidded to a stop with brakes locked. I saw other machines do almost everything but hop off the ground and fly. But above all, I saw the modern automobile pass through the most terrific ordeals that engineering ingenuity has been able to invent—and drive away under full power on all four wheels.

**T**HE scene was the proving ground of the General Motors Corporation at Milford, Mich. I should say is; for the contest is never ending. Here specimens of more than one third of all the automobiles manufactured in America, and many others from all parts of the world, race four million miles every year, consuming more than 30,000 gallons of gasoline a month. Here the car you drive is measured part by part, and is pitted against mine over the long road of time. Here new ideas in motor design and machinery face the judgment of actual performance and live or die under the stern grind.

If you should visit this place, as I did, you would find concentrated, in a twelve-mile journey over a beautiful expanse of rolling country, every conceivable kind of road and every imaginable pitfall that you and I are likely to encounter in a lifetime of driving. Hills as steep as mountainsides—level straightaways, smooth as a bowling alley—hairpin curves—mud holes axle deep—rocky roads, slippery roads, roads of concrete, tarvia, macadam, gravel and sand—in the midst of all, a magnificent four-mile speedway.

You would see, rolling over these highways, a stream of motor cars of almost every make and model, all bent on prov-



The "bath tub" test for motor cars—just what its name implies. The car plunges into a sunken road, water, sometimes mud, up to the axles, and wins through if it can. Then all the effects on every part of automobile are searchingly examined

ing their ability to serve you for any purpose and in any circumstance.

Here are answered, with scientific precision of laboratory instruments, all those questions which you and I continually ask. How fast can my car go? How much gas and oil does it burn to the mile? How fast can it pick up? How quickly come to a full stop? What parts will wear out first? How steep a hill can it climb? Will it fail or leak in wet weather? How long will it last? To these and a hundred other questions, the replies are set down in the black and white records of precise measurement. And from the story told by these records, engineers are evolving the automobile of today into the motor car of tomorrow.

In this vast engineering laboratory automotive engineers try out their ideas. If they prove their worth they are passed on to the public.

After I entered the grounds, passing among busy shops and garages, the tall young engineer who is the boss of the works drove me over the roads, showing me the 150-odd scientific tests by which he and his men judge the present-day automobile. "Pop," they call him;

though he owns to the less familiar name of O. T. Kreusser. A technical man of wide experience, he is endowed with a searching mind that digs deep for facts, and through them grasps the future.

"A few years ago," he explained as we drove down a winding road leading to the speedway bowl, "the engineer who sent his creation out to the public highway for test, resorted to a method he knew was not only faulty but hazardous. He realized that no two tests, even though run over the same road by



No questioning of the accuracy of this graph of a car's turning radius. Water, poured on the outside front wheel, writes its course on the concrete pavement and the diameter of the circle thus made is measured for the exact turning radius

the same driver, could possibly give comparable results. In one instance there might be more cars on the road than another; the wind might be different on different days; the condition of the road might have changed. Naturally such road tests were hit-or-miss, and the results were largely guess work, though they did advance automotive science.

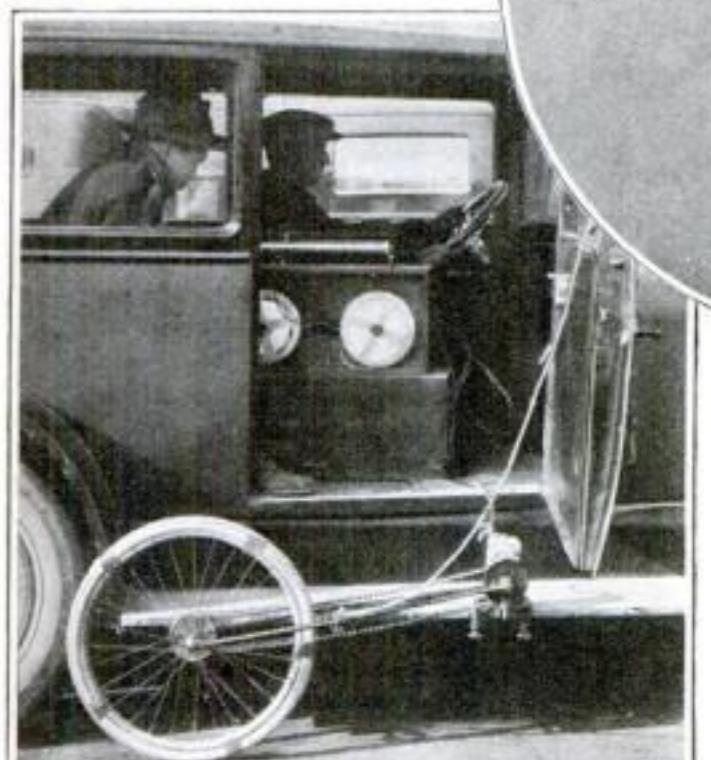
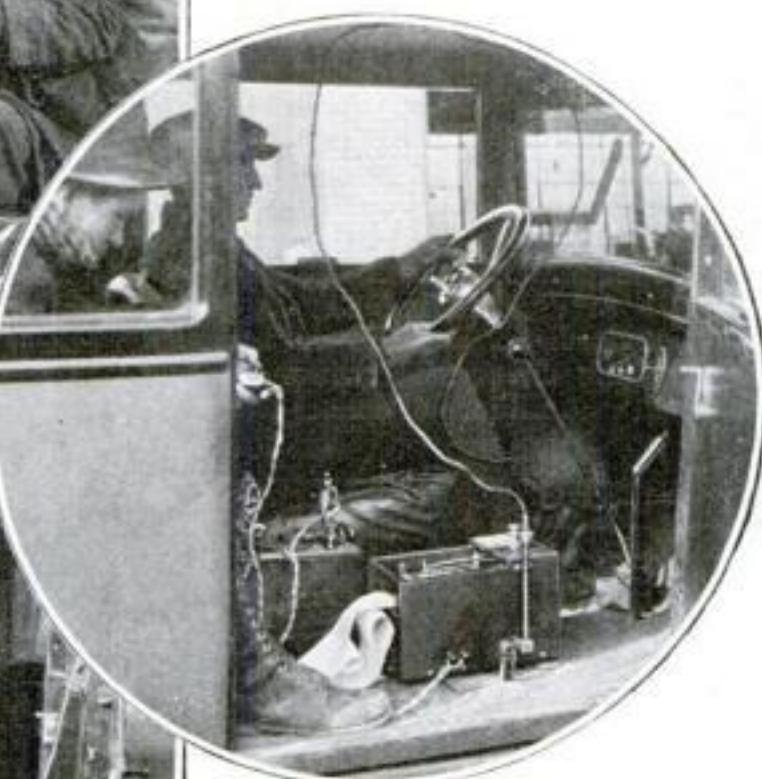
"AND so we were forced to build a private testing field of our own, and here it is."—He swept a hand across the countryside. "By special laboratory apparatus we record the performances of cars under test. These records give us a mass of scientific data, from which we can make reliable comparisons between cars driven under identical conditions.

"When an engineer designs a car he has in mind a composite customer, one who travels all over the world, up and down mountains, across plains and deserts, through wilderness and jungle, fording rivers, and bucking snowdrifts.



The "towing dynamometer" develops any resistance that is desired to the car hauling it, providing a task even more difficult than that of climbing the most precipitous hill

Measuring the pedal pressure required to throw out and hold in the clutch. The stirrup attached to the pedal is connected with springs in the framework which record the pressure as a spring scale records the weight



Recording the rate of deceleration. As the car stops a loose weight in the box shifts forward and the rate of shifting is recorded mechanically on paper roll provided for the test

The "fifth wheel speedometer" drives an electric generator. The record of the current generated in this way indicates the speed of the car and the actual rate of acceleration

A banked turn of the specially constructed concrete speedway where motor cars are driven up to a hundred miles an hour to prove or disprove their abilities to endure strain in all parts



Here on the Proving Ground we aim to duplicate every driving condition that might be encountered anywhere, and by actual tests to evolve the ideal car."

We halted at the edge of the speedway—a huge triangle with rounded corners in a valley between wooded hills, a small lake shimmering in the center.

"The largest and fastest in the world," "Pop" informed me. "Exactly three and eight-tenths miles long, and wide enough for four cars abreast. Want to try it?"

"Sure."

The track included an inside road for low speeds, an outer rim with steep banks for speeds unlimited, and between the two a channel where cars might be driven for thousands of miles. On all three scores of machines, mostly sedans, flashed by, grinding away a lifetime of wear.

Suddenly "Pop" pushed the throttle and we leaped into line on the outside road. Quickly the speedometer needle jumped to forty miles, then fifty, sixty, sixty-five. Now it went to seventy and beyond. Unconsciously I clutched the seat. "You needn't worry," yelled "Pop," pushing the throttle a notch further. "These inclined curves are mathematically safe up to 125 miles an hour. I know, because I laid them out myself."

We seemed to be flying. The wind whistled through the partly tilted windshield. My hand, tentatively stuck out into the breeze, snapped back violently against the door frame.

"Some wind resistance, eh?" "Pop" yelled in my ear. "We're cutting that down, too. Every time we make a new car we learn some new way to cut it. Not making automobiles fly yet, but give you all the speed you want on any hill or straightaway. Now look at us!"

THE speedometer stood at 75. Around a curve we went, sticking to the rim and back on the straightaway.

"Just wanted you to see what it's like," smiled "Pop" when we left the track. "Speed, though, is only one little part of the story. Let me show you."

With that he piloted me over the grounds and showed me the whole series of amazing tests to which every new car is subjected.

Every one of the forty or fifty cars which you may see daily at the Proving Ground is the same sort of car you might purchase from a dealer. The Proving Ground has bought it precisely as you would, even sometimes trading in a used car.

When a car arrives engineers first measure it throughout, checking each one of its specifications. They measure the bore and stroke of the engine, the dimensions of each bearing, the rear axle ratio, the distance traveled by each piston for every mile of car travel, the turning radius, and so on.

This done, one of a corps of expert drivers takes it out on the road for a limbering up, holding it within the specified rate of speed for the first few hundred miles. After 2000 miles it goes to the shop where mechanics tune it up for the first engineering tests. They remove the carbon, grind the valves, check the bearings for proper clearance, adjust the brakes; in short, give it the same general overhauling (Continued on page 138)

# You've Got a Patent, BUT—

*Is It Valid? Is It Marketable? These and Other Vital Factors for Success Explained*

By BRUCE DONALD

**A**S THIS is written, the U. S. Patent Office has just issued patent number 1,639,642. In the last year the office received 110,030 applications for patents, or about 366 for every working day. In the same year 346,540 letters regarding patents were received and answered. All of which means that quite a few of us Americans are interested in the subject of patents.

Most amateur inventors—who are the vast majority of those applying for patents—think their fortune is made the moment a patent is granted. But there are numerous slips between the cup of obtaining a patent and the lip of drinking in the royalties.

In the first place, the fact that a patent has been granted means only that the inventor has passed his first test. True, it means that in the opinion of the commissioner or one of his assistants, the idea is new and original and shows invention, but that opinion may be wrong and frequently is, as is proved by the great number of patents which are declared invalid by the courts.

Furthermore, the courts have held that if an inventor sells a patent which is later declared invalid, the inventor can be sued for return of the money on the ground of unjust enrichment. It therefore becomes highly important for the inventor to know something of the fine points of the patent law, and especially of the courts' interpretation of these laws.

**T**H E first thing an inventor should determine, before applying for a patent, is whether his idea has commercial value.

A patent recently granted which was found to be worthless commercially was a new method for joining the rails of a railroad track. The end of each rail, as now used throughout the world, is square where it abuts against its neighbor. This patentee would make the ends of the rails taper off sideways so that a wheel, in passing from one rail to the next, would not be off the first rail until it was already on the next. In other words, there would be in effect a continuous rail, which would eliminate the

present bump as the wheels pass from one rail to the other. This bump wears out the roadbed and is the principal cause of engine trouble.

The inventor obtained his patent and several railroad men of note passed upon it favorably, but all agreed that its application would be impossible, for in order to use it the entire trackage of the world would have to be replaced. The new type could not be used with the old, because the tapered ends would not join with the squared ones.

Two young men developed a rotary engine for automobiles. An established manufacturer offered \$10,000 for their patent. The boys had expected to get a great deal more than this and accordingly called upon a prominent engineer for advice. This gentleman reasoned as follows:

"The automobile industry is pretty well standardized. Factories are equipped for building the present type motor and it would cost millions of dollars to change

to the new type. The automotive industry is nearing its peak—if it hasn't already passed it, which would make extremely hazardous the entrance of a new company into the field to market the new motor." The engineer advised the boys to take the money—which they wisely did.

**T**HE next thing that should be determined before applying for a patent is your chance of getting a valid one. The patent law states that an idea, to be patentable, must be new and original, must show invention and must advance the prior art, that is, it must advance our previous knowledge concerning the subject in question. There is a wide difference in merely obtaining a patent and in obtaining a valid patent.

Now an idea might be entirely new yet not advance the prior art. For example, a friend of mine in the billboard business invented a neat sign holder for use on delivery trucks. The upper half of the

sign would advertise the firm which operated the truck and the lower half, some nationally marketed product. This inventor had made a count of all the trucks in several large cities and said, "It's a million dollar idea—if I can only get some protection on it."

There was the hitch. He couldn't get protection that was worth anything. What he proposed was nothing more than the old billboard made smaller and placed on the side of a truck instead of by the side of the road. It was simply a modification of the idea of putting cards inside street cars, long in use. In short, it was merely a new adaptation of an old idea and therefore not patentable.

The courts have construed that in order to be valid, a patent must show invention. Thus, merely to discover a law of Nature, such as the fact that electricity is conducted by metals, is not patentable. Likewise, in the development of machines one step naturally suggests another, and the courts will not validate a patent which is merely a further natural development of a previous idea. In the same manner, a new arrangement of an old idea, which does not result

(Continued on page 170)



The young inventor surveys the finished work of his brain and hands. So far so good. But is it new and will the world pay for its use? On the answers to those questions depend his hopes for adequate returns for his labor.

# Can the Bees TALK?



Bees know a friend—Some 8,000 of them, their stingers sheathed, crawl on the bare chest of A. D. Worthington, young Omaha apiarist

**Hive dwellers exchange strange messages and warnings; new studies reveal a civilization that rivals our own!**

By MYRON M. STEARNS

**S**TAND beside a bee-tree, or hive. Around the entrance dozens of yellow-brown honeybees buzz back and forth on the various errands of their marvelous civilization. Move slowly, and they pay no attention to your presence. They alight on the landing board of the hive, carry in their load of nectar or pollen and go out for another trip. You can watch them all day without harm or interference.

But try an experiment. Touch one of the workers as it alights, bruising it a little. Then let it go on into the hive.

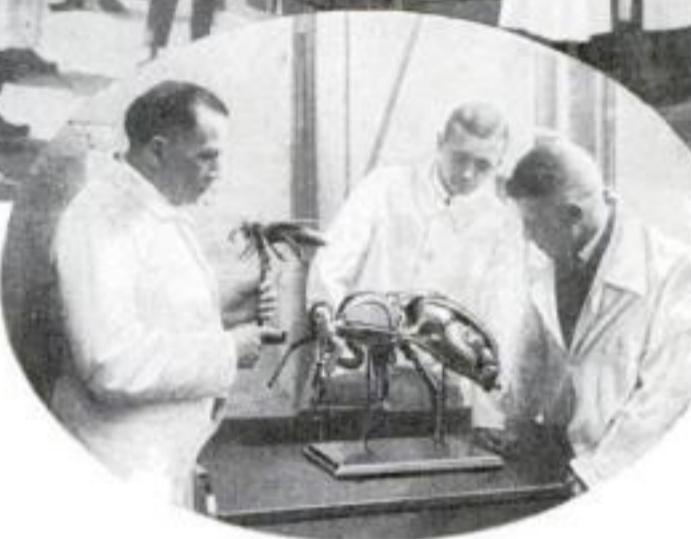
Immediately the whole swarm will come streaming out to attack you. Flight alone will save you. The bees will follow relentlessly, thousands on thousands, stinging furiously.

Almost instantaneously the bruised bee has told its trouble to the entire swarm, and changed them instantly from a population of peaceful workers to a militant army. What mystery is this? Has the complicated civilization of the bees developed a means of communication that equals our human speech and telegraphy combined?

New light has been thrown on that subject by investigations that are still going on in both Europe and America. In Germany, Karl von Frisch has been conducting experiments over a course of years, as to the bees' language. In this



Above: An instruction hive at the new bee-keeping institute at Erlangen, Germany. It is provided with windows that enable the students to study minutely all activities of the honey makers



Left: Professor Zanden, an expert of the new German institute of bee culture, explaining the anatomy of a bee to two pupils, who study a huge model insect as he indicates its organs and their functions

country, Dr. Frank E. Lutz, of the American Museum of Natural History in New York, is carrying along an investigation to learn how bees locate and recognize certain flowers.

Von Frisch caught and marked some 600 bees out of a swarm of about 40,000. He used spots of unwashable colors—white, red, orange, yellow and green—on the head, back and abdomen in different combinations. Thus, by comparing the colors with a chart, each bee could be recognized.

**D**ISHES containing honey were set out on tables at some distance from the hive. Presently, sometimes after days, a bee discovered the honey. As soon as it had taken all it could hold, it headed back for the hive. Within a few minutes, other bees went to the honey; the news had been communicated to them.

The next investigation was to ascertain whether information as to exact location of the honey was given. Honey was put in a dozen different places. Bees from the hive quickly visited each of these places, first searching the immediate vicinity and then hunting in constantly widening circles for the supply of which they had received word. They found it all.

As strange an instance as any of com-

munication is furnished when bees swarm. The entire colony of 60,000 or 80,000 divides into two sections. Ten thousand or so will carry on about their usual duties; the rest follow the queen bee from the hive. Her flight is short, for it is, usually, only the second time in her life that she has left the darkness of the hive and used her wings—the previous occasion having been the nuptial flight when she came to be queen. As soon as the queen has alighted, on a tree limb perhaps, all the bees of the swarm gather about, alighting one on another until they form a solid mass. There they wait until word is brought to them of the location of the new hive.

Now we come to one of the most marvelous things of the entire performance. Scouts that have started out to find new locations go to the swarm and apparently tell of their discoveries. Presently—it may be a few minutes or twenty-four hours—the whole swarm suddenly lets loose, disentangles itself and *flies straight to the new location!*

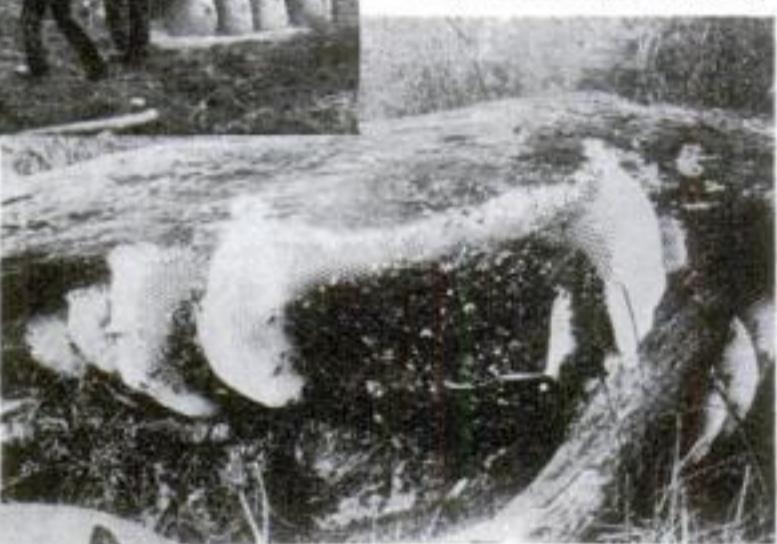
**A**PPARENTLY, every individual knows exactly where the swarm is going, the locations found by the scouts having been discussed and the new home decided upon. It is usually some distance—miles, even—away.

Other news also travels fast. If the



Left: The largest bee market in the world, at Veenendaal, The Netherlands. This is a typical scene, showing rows on rows of hives brought from many countries, at an annual event in which millions of the useful little insects are sold

Below: Seven combs of honey on the outer bark of a tree in Australia and the wild bees that produced the crop. The insects generally build beyond reach of animals, but these ran the risk of disaster and, as the picture shows, successfully



queen bee, for instance, is taken from the hive, word of the calamity travels throughout the colony and within two or three hours, every bee quits work. But if the queen is restored and starts again on her ceaseless round of laying two thousand or more eggs a day, then in a few hours all the bees resume labor.

Although bees are as old as the human race, for centuries little definite knowledge concerning their life and habits was available. They are considered "domestic," and are bought and sold, but have never really been tamed. They have unparalleled engineering skill, building mathematically perfect structures that, for man, would be half as high as the Woolworth Building. They divide the labor of the hive among themselves more perfectly than any society civilized man has yet been able to organize. They have a spirit of self-sacrifice for the good of the hive—which is usually a measuring-stick by which the advance of group-civilization can be measured—that humankind has never even approached.

THE sting of a bee, for example, can never be used in self-defense; it can be used only in defense of the hive, for its use brings death to the bee that uses it. The creatures show marvelous ingenuity in overcoming obstacles. For instance, sometimes a mouse will get into the hive and be stung to death. The corpse is too big to be pushed out of the door. To save the hive from the pollution of decay, the bees build a hermetically sealed tomb of wax about the body of their victim.

Until after 1700, practically nothing was known of what went on inside the hive. Then René Antoine Ferchault de Réaumur, scientist and naturalist, invented a hive made in part of glass. His device has been improved upon, until now, in glass hives furnished with black curtains or shutters that can be opened or closed to meet an observer's needs, the



Left: The hind legs and quarters of bees, showing the baskets provided by Nature for carrying pollen from flowers to hive

Below: An apiarist searching among thousands of bees for the queen, which will be used for the start of a new hive



activities of bees can be watched day or night—whether they are hanging in black clusters "making wax," or fanning to keep the air in the hive circulating, gathering on top of the combs to regulate the hive temperature, building, filling, or sealing the honey cells, or cleaning out the cells and corridors of the hive. Maurice Maeterlinck had a glass hive in his study and even in the center of Paris his bees were able to find flowers enough for their needs.

In the office of Professor Hover of the Ypsilanti Normal School, there is a large observation hive with barometer, thermometer and methods of recording sun-

shine and many other things that bear upon the life of the bees. The weight of the hive is carefully recorded each day. The weight drops about two pounds between eight and eight-thirty A.M., when 10,000 or more of the field workers leave to begin foraging. At night the hive weighs five or six pounds more, due to the nectar accumulated. In the afternoon there is a sharp half-pound drop, when 2,000 young bees start out on practice flights. The weight chart shows increases when fields of white clover or alfalfa bloom. During each night there is a drop of two pounds or more, caused by the evaporation of water from the nectar, due to the fanning of the bees. Before a rain there is a gain of a pound and a half in ten or fifteen minutes, when 7,000 or 8,000 field workers come driving back to the hive. How they are able to forecast weather so perfectly and know that rain will be coming soon, we do not know,

but their prescience is infallible.

The weight curve records also a drop when, tempted out by early spring, old bees that have spent the winter in the hive resume their nectar gathering and die on the job, a thousand a day.

Von Frisch found that any worker who had discovered an unusual honey supply executed, as soon as she returned to the hive, a set of queer little side-steps that took her in circles through the thousands of bees. Immediately they crowded up to the visitor, felt her with their antennae, or feelers, and in turn became excited. The discoverer extended a protuberance in the abdomen. This procedure gave off a sweetish smell that could be noticed at a distance of a few inches, even by humans. Evidently this scent played a part in communicating information to other bees.

AS WITH many other insects, the antennae of a bee are important in many ways. Besides being used in communication, they help the bee to find its way in the darkness of the hive, to recognize friends or enemies, and so on. There are some 12,000 hairs on a bee's antennae, and 5,000 "smell hollows." Unquestionably they have a sensitiveness that enables the bee to record faint impressions with an accuracy almost unimaginable to man.

Just as the "honey dance" called attention of other bees to the fact that there was a good supply of honey in the neighborhood, a "pollen dance" gave information concerning pollen. Evidently the information conveyed specified also the kind of flowers.

Investigations in this country seek to ascertain how bees can recognize particular kinds of (Continued on page 157)

# New Methods of Traffic Control

How cities are solving the problem caused by 22 million automobiles—A \$13,000,000 elevated street for New York—Millions for widening Chicago highways—Novel plans for regulation in typical communities

By EARL CHAPIN MAY

**M**ORE motor cars, more roads and then more motor cars. That is the traffic merry-go-round on which experts and plain individuals are riding faster every hour. Since 1902 or thereabouts our gasoline-driven street and highway vehicles have increased from practically nothing to 22,330,000 motor cars and trucks.

The situation is acute, for transportation is the life blood of society. Every city has its own problem of street traffic regulation, and, since each novel solution may be applied with variation in some other population center POPULAR SCIENCE MONTHLY has selected examples in a nation-wide survey.

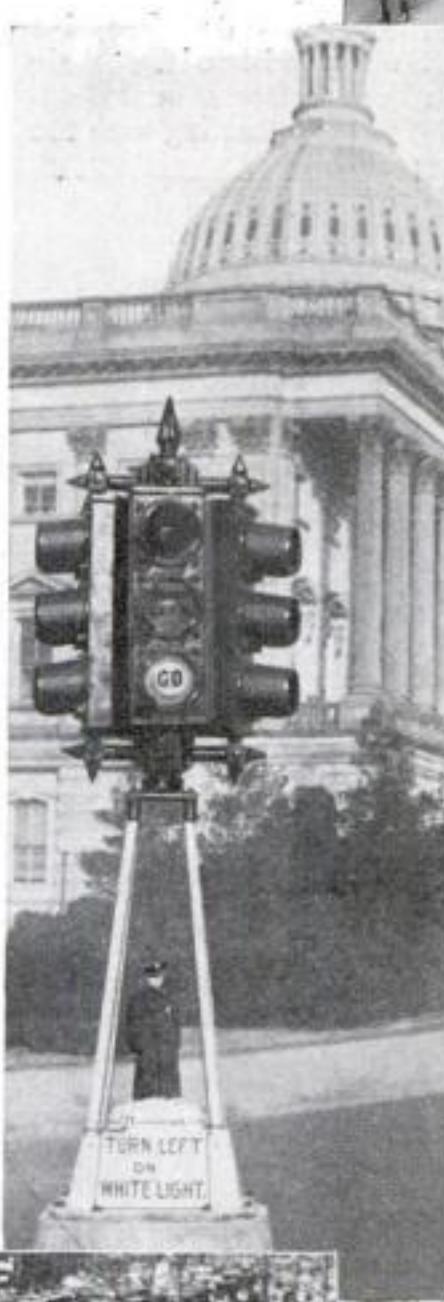
Greater New York offers, of course, the greatest problem. The three mounted policemen who were assigned to manage motor traffic in Fifth Avenue in 1903, assisted by a hundred blue and white signs directing slow-moving vehicles to keep near the right-hand curb, would have a tough time with the 600,000 motor cars now registered in the metropolis, plus the thousands of visiting cars which now fight with 5,000,000 pedestrians for possession of the 4145 miles of streets.

**D**URING business hours more than 2,000,000 men and women enter the area between Fifty-ninth Street and the Battery.

To meet this situation New York is placing 2243 pole traffic control lights at inter-sections to do the work of 4486 traffic policemen whose salaries would total \$13,315,000 a year.

Along the Hudson Riverside Drive will be extended southward to Canal Street,

on a \$13,000,000 elevated motorway seventy feet wide. A second deck, if needed, will cost \$9,000,000. On such a motorway, with no cross traffic to cause waits, 1200 to 1800 cars can pass a given point each hour. Along the East River in Manhattan north and south streets will be widened, and with the \$1,600,000 widening of Depew Place, around Grand



Above: A powerful electric traffic control signal tower in Washington. This arrangement, successful in Sixteenth Street, so heavily travelled, will be established on other thoroughfares in this city



Below: Part of the growing traffic problem that a committee is trying to solve in San Francisco. A maze of street cars, motor cars, trucks and people photographed at Fifth and Market Streets



Part of Boston's traffic stream that something will have to be done about. A view along Boylston Street. Boston has only 225 traffic policemen

Central Station, 4500 cars can move hourly along its roadways in and out of Park Avenue.

But such gigantic improvements cannot solve the parking problem. Hundreds of many-storied garages and arcades for unloading trucks will help, but eventually all parking on downtown streets must be forbidden.

In Philadelphia the street railway has opened several parking areas just outside the retail center. Motorists pay 25 cents to park all day and ride in and out on the railway.

**F**ROM Chicago prairies stretch north, west and south. Such a city, one thinks, should not have trouble finding room for motor cars. But Chicago and its county, Cook, are spending \$32,000,000 on bigger and broader thoroughfares.

The construction of the wide, jack-knife Michigan Avenue bridge, the double-decking of Wacker Drive and the widening to forty feet of most of the main arteries are just the beginning. In addition the Chicago Plan Commission is proposing an elevated boulevard system from the "Loop" to the northwest side, where it will "diagonal" into an eighty-mile boulevard encircling the outer sections. Eventually other diagonals will radiate from the center. But this plan, reminding us of Washington, provides for other by-pass loops leading to the suburbs.

To solve its traffic problem, St. Louis has bonded itself for \$80,000,000. Its celebrated Olive Street will become a hundred foot artery from the central business district to the West End. Special districts will be benefited by the widening of Vandeventer and Enright Avenues, while Cote Brilliante and Denny Road will be widened to one hundred feet. One-way streets are utilized and at rush hours parking is prohibited in a district of two square miles.

Detroit's outstanding achievement is the widening of Woodward Avenue and its extension to Pontiac, sixteen miles northwest. This latest type of "super-highway" is two hundred feet wide, with

twin one-way motor roadways forty feet wide, and tracks in the center for transit lines. Automobiles do the sixteen miles in forty-five minutes.

Detroit also has an interesting method of wrestling with illegal parkers. Formerly the twenty-five percent of those tagged who really reported clogged the courtroom hopelessly. Now they step into the Traffic Bureau and pay "assessments" instead of fines.

Pittsburgh has yet to discover an adequate remedy for traffic conditions on the narrow streets and irregular intersections of its "Golden Triangle." Some streets have been widened and authorities plan to tear down the county jail and other buildings, thus opening arteries into the central business district. But left-hand turns and irregular corners make automatic signals largely impracticable.

After battling with a complex set of traffic regulations about parking, one-way streets and turns to right and left, motorists of Boston have finally committed the city to a \$4,000,000 widening of Cambridge Street through which it will be possible to reach the northwest suburbs. This followed a \$4,000,000 opening, east and west, between the Back Bay and South Station, and another \$3,000,000 widening of Tremont and Dock Streets, the latter in the market district. Boston has 225 traffic policemen and just one multiple-light signal pole and two signal towers—the latter presented by a merchant doing business hard by.

**S**AN FRANCISCO is having troubles with jay walkers. A committee of civic leaders, with engineers and city planners, are conducting a survey, with the idea of framing city-wide traffic rules. Meanwhile San Francisco has relieved dangerous congestion at the Ferry Building by completing a subway a thousand feet long.

Los Angeles, with 590,000 automobiles, points with pride to automatic traffic control signals at more than 300 intersections. At all others pedestrians have the right of way. But, between crossings, jay-walking is a misdemeanor. Double-line parking is forbidden and frequent loading zones provide for

handling merchandise.

A major traffic plan provides for widening of the main arteries to one hundred feet, the next class to eighty feet, and the bounding of the business district with 120-foot avenues.

Milwaukee is widening main streets and co-operating with the



Park Avenue, New York, where middle parking is being removed to make room for motor cars which overtaxed the capacity of lanes on sides

county to build wide highways outside the city limits. The value of the by-pass is better understood there than almost anywhere else.

Washington, first and only one of our large cities laid out on the cartwheel plan, has proved the practicability of light control, at least on its heavily travelled Sixteenth Street, and other diagonal arteries will have the same control this year. The standard speed limit is thirty miles until the congested district is reached. Sidewalks have been narrowed to give more motor room and parking is limited to thirty minutes in busy streets and hours.

At Williamsport, Pa., the traffic officers present to both motorists and pedestrians cards warning the former that white safety lines mean "slow up," that pedestrians should travel only between those safety lines and that red means "danger" everywhere.

Madison, Wis., has partially solved its peculiar problem by sending all traffic to the left as soon as it enters the great state capitol square. Madison's population of 60,000 lives, principally, on a strip of land between four lakes.



Chicago is spending \$32,000,000 to relieve traffic congestion with wider streets and elevated ways. One street will be double-decked. A boulevard will encircle the city. A view of Michigan Boulevard



Times Square, New York, looking north. Here, where Broadway and Seventh Avenue merge, one of the most difficult traffic problems is solved

This strip, at the capitol, is only a half mile wide. In addition to regular streets laid out like the square on cardinal lines, four large diagonals enter, one at each corner of the square. As Madison is also a tourist center in summer and has much through traffic between Minneapolis and Chicago, it has installed a system of by-passing, in spite of local merchants' protests.

Denver issues a traffic accident map which shows the high accident points for each month. Marking these points with buttons and beacons has almost eliminated accidents.

Knoxville, Tenn., was one of the first cities to install a regular tower control system. That system is still getting good results, but changes may follow the report of a city planning commission.

Aberdeen, S. D., has a Courtesy Club which asks its members not to park on principal business streets during trading hours.

**M**EMPHIS, TENN., although it has cut through some dead end streets, opened others, widened still others and is planning to extend its main artery for heavy traffic, finds the parking problem uttermost. The city has opened free parking space on the river front and in the congested district, but will probably soon forbid all main street parking.

In Oregon cities school children are taught road rules for both motorist and pedestrian.

Savannah, picturesque and conservative, believes in using its chief business streets to park cars. As Commissioner of Police John Foy phrases it, "We have suggested to the business men, largely through the press, to have their employees, as well as themselves, park their cars several blocks from the business section in order to give parking space to those who desire to trade and do other chores in business. Of course, this has no force and is like 'Putting water on a duck's back.'"

Arthur D. Hill, director of Toledo's Department of Safety says that downtown parking is his greatest difficulty but that a program of street widening will be started this year.

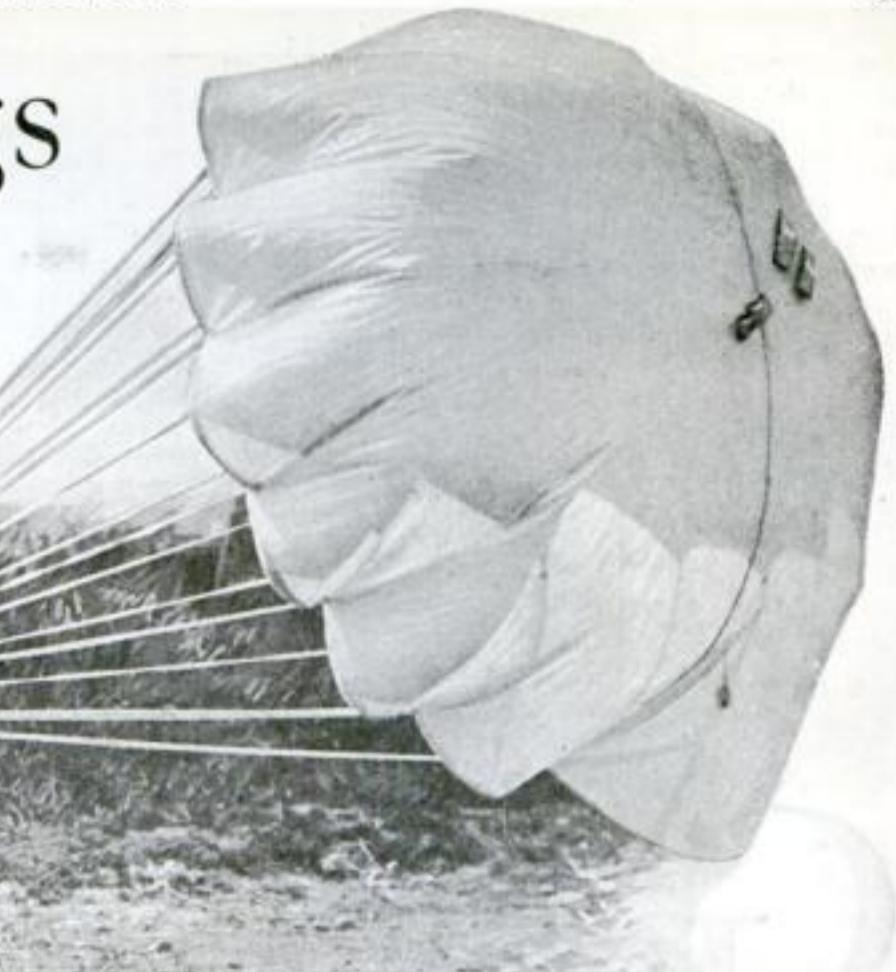
Cleveland believes in speed. Edward J. Donahue, commissioner of traffic, says, "Our biggest

(Continued on page 134)

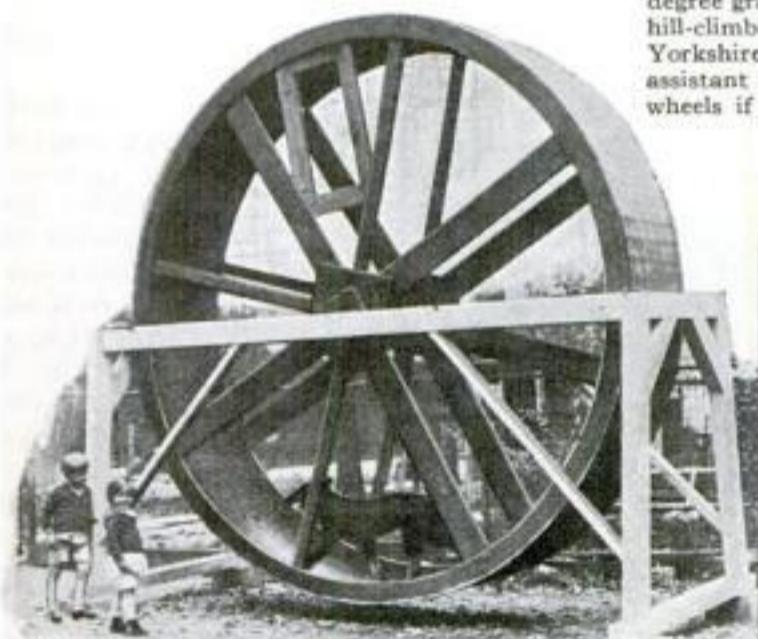
# Curious Things People Do



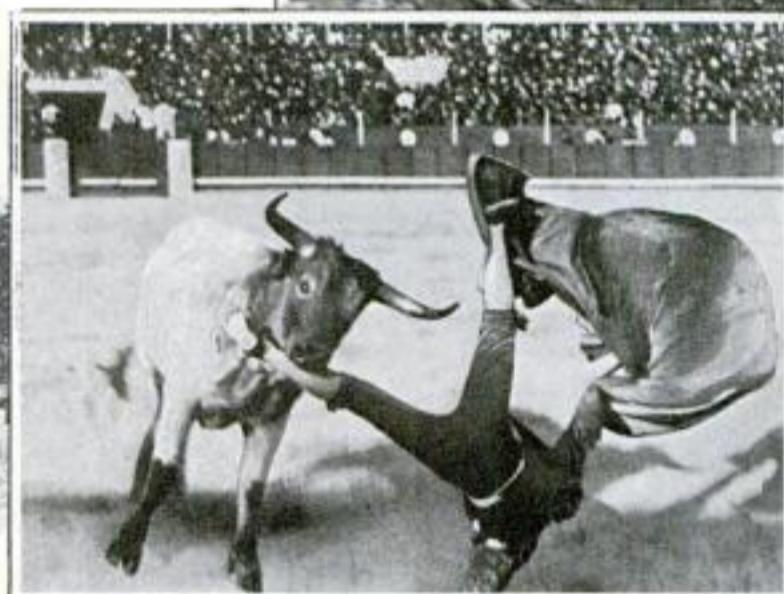
A thoughtful parent at Brighton, England, hitched a parachute to the baby carriage. Result—it entertains the baby and lightens the nursemaid's task



The driver at the right took no chances on a thirty-three degree grade during a recent hill-climbing contest in Yorkshire, England. An assistant followed, to block wheels if the engine failed

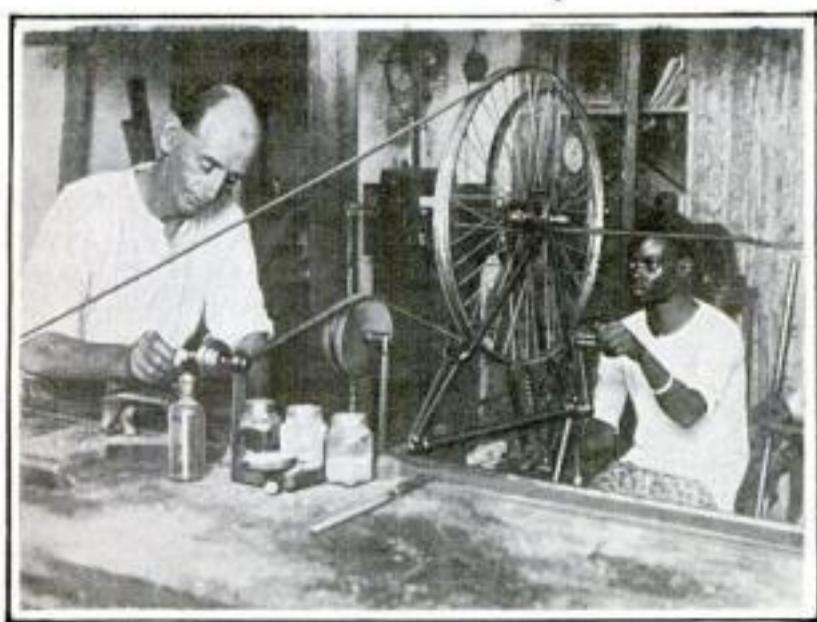


Shepherd dogs are trained to run as fast as thirty miles an hour in this treadmill wheel, 12 feet in diameter, devised by Dr. J. W. Sherer, West Orange, N. J.



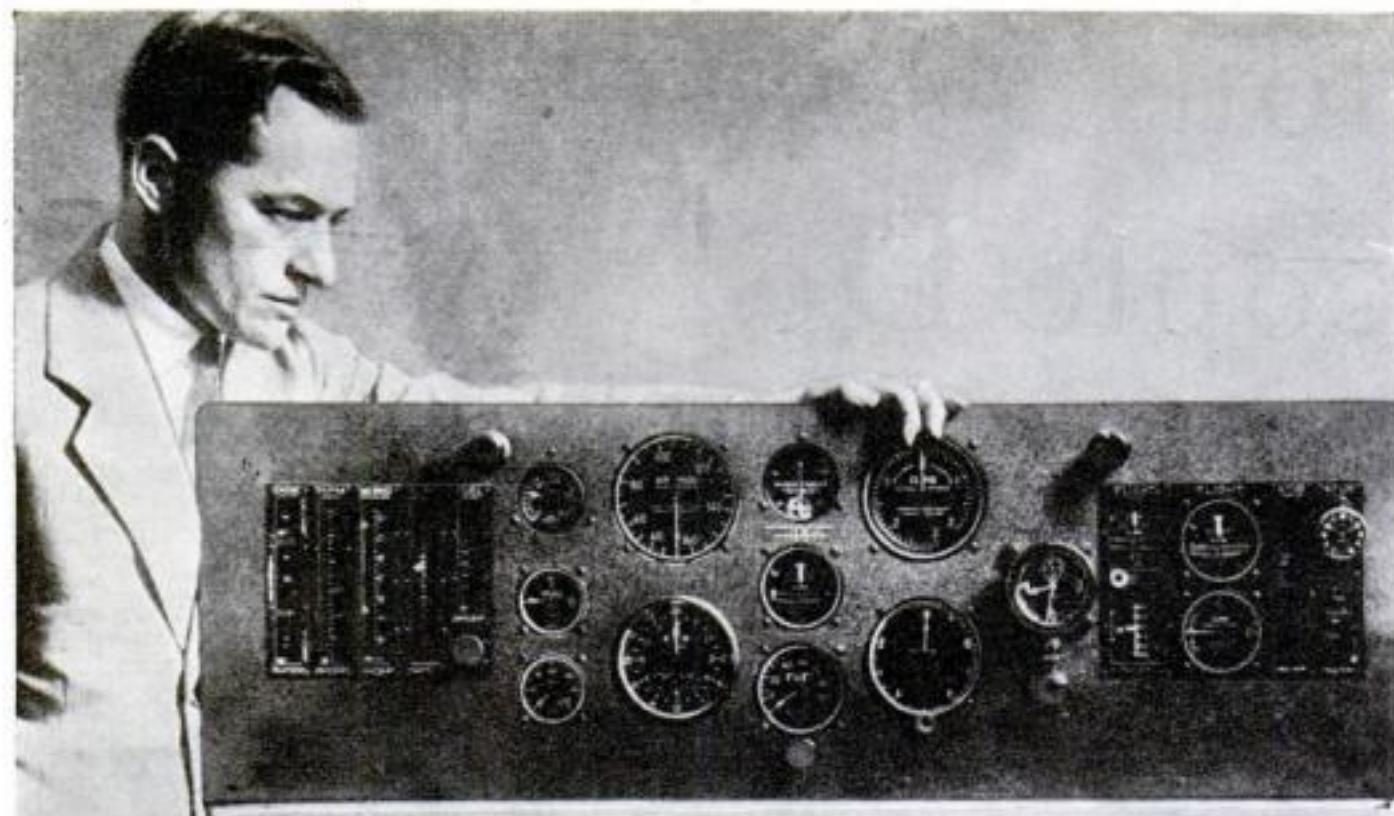
The remarkable snapshot, left, shows the upset of a bull fighter in Spain when he failed to jump fast enough to escape the rush of the animal he had enraged. Attendants saved him

Like a discarded street car, an out-moded air liner between England and the Continent has been bought by an Englishman, and converted into the summer playhouse pictured below



A maker of ivory curios in Rhodesia, Africa, has an unique power plant—a bicycle wheel turned by a native. A belt from the wheel, mounted and with tire removed, drives his lathe





Charles H. Colvin, head of the Pioneer Instrument Company, the concern whose navigation devices, such as the earth inductor compass, make possible the epochal flights across the oceans. He is shown with a modern airplane's instrument board.

# Geniuses Who Created Planes of Air Heroes

*Little Stories of Fokker, Colvin, Lawrance, Bellanca and Hall, and Their Contributions to Aeronautics*

By H. A. BRUNO

**H**IGH above a New Jersey flying field a giant monoplane soared gracefully, its three motors roaring. In the cockpit sat a rather stubby man with ruddy face and genial smile—alone at the controls, and seemingly oblivious of a group of high Army and Navy officials who rode in the cabin as passenger-observers.

I chanced to be with the officers and overheard their conversation as they praised the new plane for its unusual stability. At an opportune moment I left my seat, and, stepping forward to the control compartment, repeated to the pilot what I had heard.

"Is that so?" he smiled. "Then I'll show them just how good she is!"

With that he opened wide the throttles of the three motors, and pulled the "stick" back into his stomach. I gasped as the nose of the machine rose high, and the great plane climbed straight up until it was literally hanging from the sky on its propellers!

**B**UT that was nothing to what followed. Cutting the ignition switches on all three engines, the pilot calmly released the controls, left his seat, and slid back into the cabin. There we were, riding the air in a plane that was pilotless and powerless! Amazement on the faces of the officers changed to dismay as the machine stalled, then slid tail first toward the earth. For a few sickening seconds it dropped; then, as if conscious of its own destiny, brought its nose down, leveled out and flew itself a little way. Again it started downward and again leveled out.



Donald Hall, 29-year-old engineer, who worked day and night to design Lindbergh's transocean plane in twenty days

Now the little man climbed back into the cockpit. Still smiling, he pushed the controls forward, and, as the machine nosed down sharply, threw on the ignition switches, starting the three motors. A wide circle of the field, and he brought the plane to earth for a perfect landing.

No more startling or convincing demon-

stration of airplane stability ever was attempted. Yet the man who performed the feat was no dare-devil flyer, nor even a professional test pilot. He was Anthony H. G. Fokker, designer and maker of modern airplanes. And the machine in which he did it—the product of his own ingenuity—was the first of a new line of monoplanes which later carried Commander Byrd to the North Pole and across the Atlantic; which transported Lieutenants Maitland and Hegenberger from California to Hawaii, and which will undoubtedly write many another brilliant page in the future history of aviation.

**A**NTHONY FOKKER is just one of a small group of hard-working men, to whose technical skill and passionate devotion to the science of flight we owe the recent splendid achievements in aviation. The names of the flyers—Lindbergh, Byrd, Chamberlin, Acosta, Maitland, Hegenberger, Balchen, Noville and others—have become household words. Yet how many of us know of those other, unsung heroes—dreamers and builders, creators of airplanes, engines and instruments that have done "the impossible"?

Fokker, Bellanca, Hall, Lawrance, Colvin. Do you know who they are and all they have done?

Come behind the scenes, if you will, and meet these five workers of marvels. Three of them—Fokker, Giuseppe Bellanca, and Donald Hall—are designers of airplanes. One, Charles Lanier Lawrance, is a builder of engines. And the fifth, Charles H. Colvin, is an inventor of aeronautical instruments. Together, they

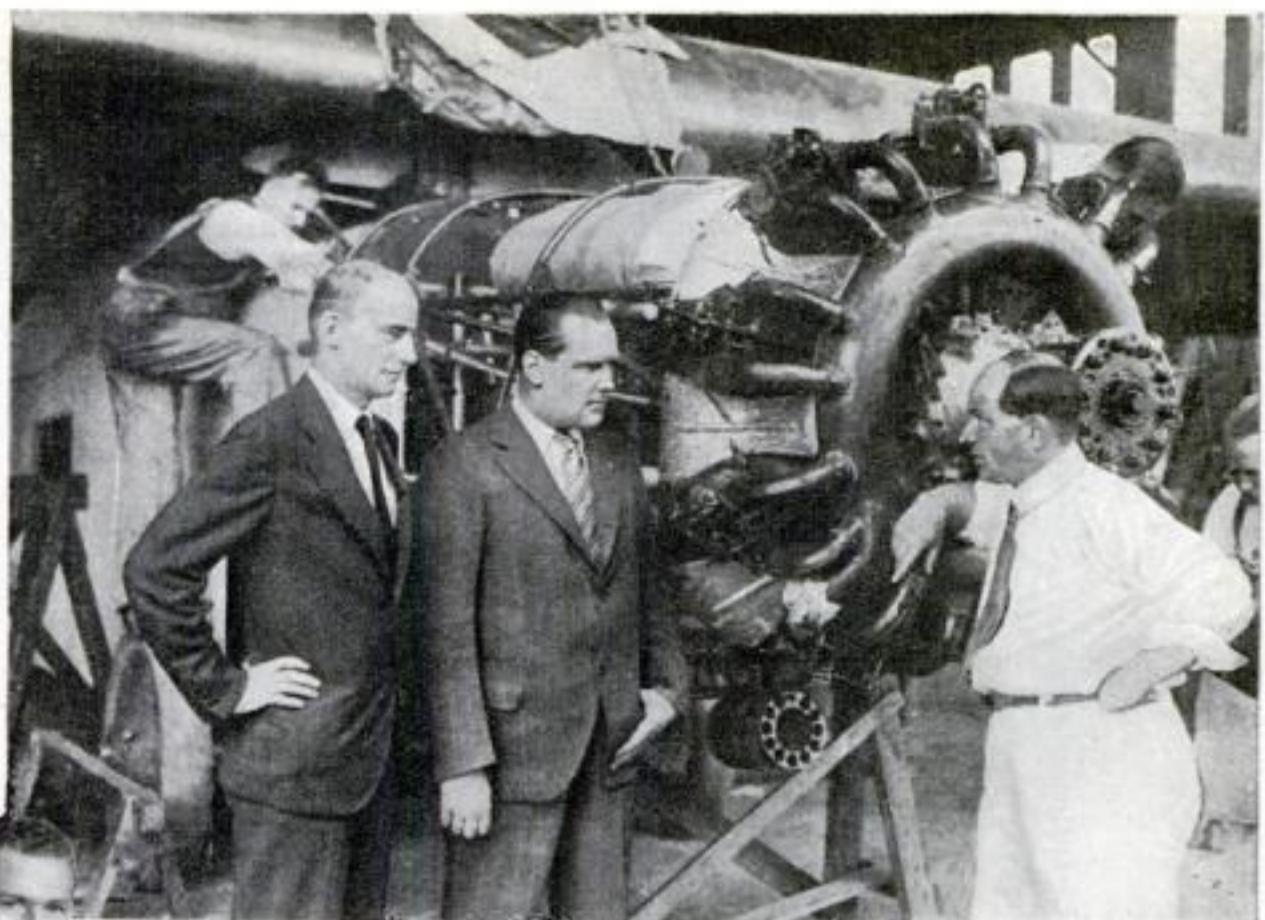
have helped toward safe aerial navigation through fog and storm, over thousands of miles of sea and land. Three of them are American born; two came from foreign lands. All are comparatively young.

Fokker, at thirty-seven, has designed planes which have led in the mastery of the air in war and peace. Today there seems no limit to the aviation projects centered around his genius. The secret of that genius seems to lie in an undying boyish passion for things mechanical, and especially for flying machines. Born at Kediri, Java, the son of a Dutch planter, he spent more of his school days rigging up mechanical contrivances than at his studies. Stirred by the success of the Wright brothers in flying a heavier-than-air machine, he began to build model aircraft and to experiment with his own ideas.

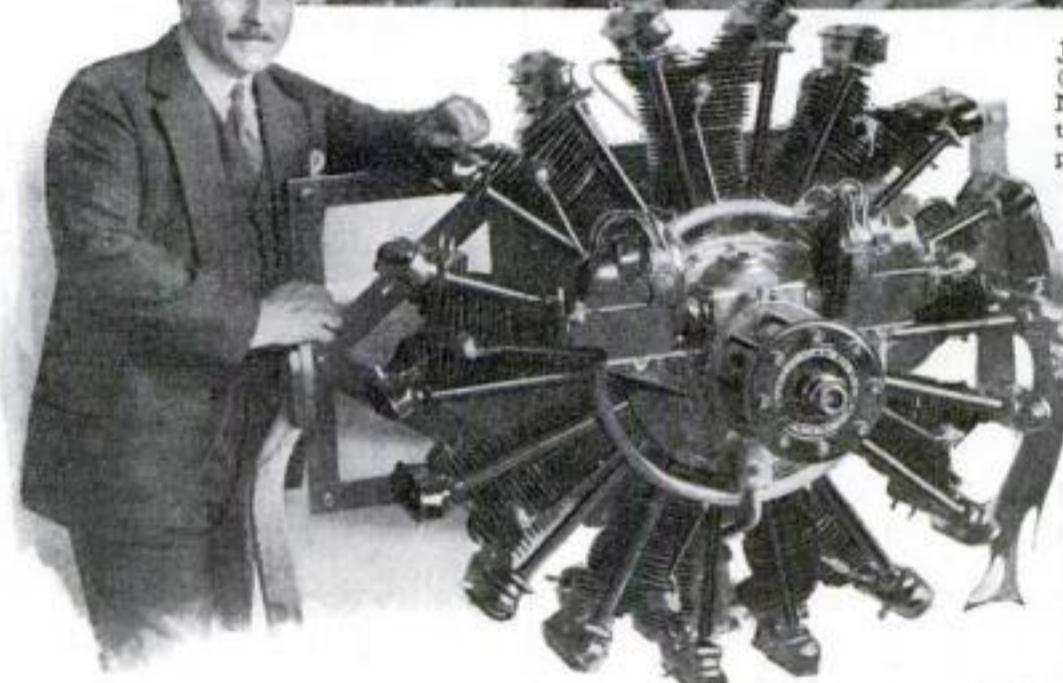
At twenty-one he took his first full-sized monoplane to an airdrome in Holland to try it out. Experts smiled and said the queer contraption would never fly. It flew. Next year the young designer flew with the same plane in the Russian Military Competition and won.

Then, to show his homefolk just how good his airplane was, he winged from Berlin to The Hague—a remarkably long flight in those days. Still, Dutch officials laughed at him. So did British experts. Germans didn't. His offer to build airplanes for the British government was refused, so Fokker contracted with the German government two years before the war to instruct military pupils and build airplanes.

#### The Fokker School



J. D. Hill (left) and Lloyd Bertaud (middle), who attempted to fly from New York to Rome, talking with Anthony H. G. Fokker, builder of the plane they used, similar to that shown



Charles L. Lawrence and his creation, the Whirlwind air-cooled motor, which has helped make airplane history by driving the craft that shattered records



Bert Acosta (left), who flew the Atlantic with Byrd, Giuseppe Bellanca (middle), builder of the *Columbia* (shown in the background), and Clarence Chamberlin, who flew it to Germany

soon became famous. When war began, Fokker turned his attention to building fighting planes. The model the British experts had rejected became a menace to the Allied front. Nor did the young inventor limit his genius to airplane designing. He worked out methods of synchronizing the fire of a machine gun with the turning of the propeller in such a way that the pilot could fire through the propeller, thus aiming with deadly accuracy, as if his plane were a rifle.

When the war ended, Fokker, who never had relinquished his Dutch allegiance, returned to Holland and established an airplane factory, which today is building airplanes for many governments and commercial airlines in Europe and South America. Three years ago he came to America and began manufacturing Fokker planes at Teterboro Airport, Hasbrouck Heights, N. J. Here were built Commander Byrd's famous planes and others that have made history. Here today still others are being constructed for further conquests.

Unlike most designers, Fokker is a pilot as well. He enjoys nothing better than to take his new machines up for the test. He is so in love with his work that he sleeps only four hours out of every twenty-four. The rest of the time he is busy giving shape to his ideas. Such is the genius who created the *America*.

Nearly ten years younger than Fokker is the designer who conceived the plane which Lindbergh flew to Paris. He is Donald Hall, consulting engineer of the Ryan Airlines, makers of Ryan monoplanes.

One day late last year, Hall was at work in his office (Continued on page 159)

# An Oil Subway of 90,000 Miles



A difficult piece of oil pipe laying. Workmen running part of a big line through a treacherous swamp and a creek in an operation near Luling, Texas. Oil flowing through this tube eventually reaches New York

**M**Y ADVICE," said the judge, "would be to kill the man the first time you see him. This court would not punish you, for he has publicly threatened your life, and anything you might do to him will be construed by this court as self-defense."

The speaker who recently gave that astounding authorization was a Louisiana judge. He was addressing the representative of a great oil company, a visitor to that state to obtain a right-of-way for a new oil pipe line.

Difficulties had arisen that required the tact of a prime minister. Farmers whose property the proposed line would cross indignantly refused to sell the necessary rights to the land. They had to be persuaded, mollified, offered large sums of money. Most of them at length had acquiesced. But in one district the natives, led by one farmer, flatly refused.

After an interview with the oil man, the farmer-leader changed his mind. For a substantial gift of money, he would persuade his group to sell the rights. But the oil representative, going direct to each of the landowners, won them over.

Flourishing a gun, the enraged leader burst into the oil man's office. The company had cheated him out of his money, he said; and he swore to shoot the right-of-way man on his first appearance out of doors. It was then that the alarmed manager took his troubles to the local court.

Fortunately, the oil line was eventually laid without a tragedy. But this incident typifies one of the innumerable problems that confront the pipe-line men. Besides the human obstacles, they

must deal with desert heat that makes wood fires unnecessary for pipe-bending; with swamps and mires in which their oxen, only possible form of conveyance, sometimes sink from sight and disappear; with floods and with snowbanks alike.

Why? So, for one reason, that you may run your automobile. If the mighty underground rivers of crude oil that flow across the country were suddenly cut off you might drive to the garage one day to find its "gas" pumps padlocked and its oil wagons stored away. Like a great network of transcontinental aqueducts, this pipe line—ninety thousand miles of it, the U. S. Bureau of Mines reports—delivers crude oil direct from the wells to Chicago, New York, San Francisco.

**F**EW know that a subterranean pipe conveys oil from Texas wells to the great refineries at Bayonne, N. J., or that others hardly less important than this "trunk line" feed western cities with the black fluid that makes the wheels go 'round. Yet even now, perhaps not far away, one of these hidden streams may be flowing beneath you on its four-mile-an-hour course toward the service of mankind.

Drawn from the latest available information, the map on the next page shows where the pipe lines run. Small "gathering" lines from the oil wells feed the great trunk lines that traverse the country. Each year five thousand miles of new pipe connect the latest wells discovered to the system.

You might stand upon an oil line and never know it; telephone and telegraph



Mainly muscle holds these sections of oil pipe together until they are welded by oxy-acetylene in Texas. On the swampy soil it is impossible to build temporary foundations to support the pipe

## Men Fight Nature and Even Wage War on Each Other to Lay Network of Pipe Lines

By ROBERT E. MARTIN

lines are the only visible indication that one runs beneath. Through them a "chief dispatcher" controls the oil flow. Pumping stations, generally about forty miles apart, execute his telegraphed orders. At each one, a large storage tank takes up the overflow and also relieves gas pressure in the eight-inch pipes of the main oil lines.

Across mountains, deserts, rivers and prairies men toiled to lay the pipes—"hard-boiled," brawny men whose pleasures are oaths and who regard eating and fighting as of equal importance. So difficult to handle were the workers on a California line that the foremen hit upon a novel scheme to prevent their carousing by night and recovering by day. By connivance with the town police, the worst offenders were corralled early each evening and sentenced to spend the night in jail on trumped-up charges. Next morning they were collected in the best of health for their strenuous tasks and put back on the job.

**T**HESE are the men who seize the pipe as it arrives by truck over almost impassable swamp or canyon roads and who piece it together to make the finished line. Sometimes they screw the pipe together, often they weld it. At night the open end must be plugged, or it will be filled with small animals of every description. On the heels of the pipe-laying crew goes the ditching crew, who bury the line in the soil. The usual rule is to bury the pipe about a foot and a half in cultivated land, less across timber and pasture and more where the temperature is cold enough to congeal the oil.

Mules, men and machinery laying an oil pipe line. Sections being welded by oxy-acetylene process



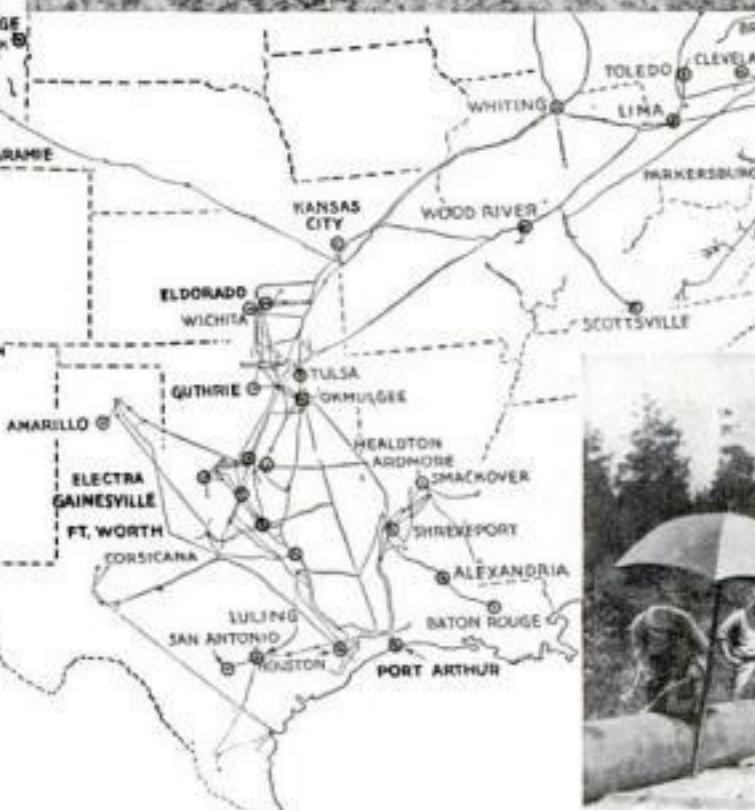
Courtesy of Petroleum Publishing Company

This map shows the principal oil trunk lines and gathering or feeding lines in the steadily growing network that now approximates 90,000 miles. Eight hundred million barrels of crude oil pass yearly through these pipes to the oil refineries

But sometimes an oil line pops out in an unexpected place. When it is impossible to run it up and down steep cliffs to cross a ravine, the pipe bridges the air gap on suspension cables. It plunges without hesitation into rivers, to bury itself in the bed of the stream.

**D**ANGER threatened the layers of the Wyoming line, in the dry river beds' rocky sand. Frequently acetylene gas generator wagons, used to feed the welders' blowtorches, tipped over as they were being hauled through. To prevent explosions, the wagon doors were left open. At each upset the entire contents of the generator were spilled—a waste of acetylene, but a necessary precaution.

Huge umbrellas to shield the welders from the sun made possible the laying of the Oklahoma pipe line. Here wood fires for bending the pipe were dispensed with. Under the sun's scorching rays, the metal became hot enough to bend. In such a climate, the pipe must be buried in the early morning before the sun's heat is felt; otherwise it expands and jumps out of the ditch.



Welding an oil line under umbrellas in southern United States. Some pipes were heated for bending by sun rays



First, engineers carefully survey a locality and decide where a line shall run. Then come the diplomats, the right-of-way men, with their winning smiles and their persuasive arguments, and money. To procure a right-of-way for its 11,200 miles of pipe, one company had to deal with 84,000 people. At last all is ready for the shock troops—the gangs that fell trees, remove undergrowth and bridge gullies to smooth out the rough spots in the way of the pipe-layers.

**M**EANWHILE the pipe is being delivered to the out-of-the-way places along the oil line. Sometimes resource is called for. Faced with the sudden necessity of unloading several cars of pipe in an isolated town, with no workmen available, one California foreman enlisted the aid of the local justice of the peace. Prisoners in the town jail for minor offences were pressed into service and promised their liberty as soon as they unloaded the cars. Though the temperature was a hundred and ten in the shade, that job was finished in record time!

Down the line come the pipe-laying

and ditching crews, of from thirty to fifty men. They can lay a mile of pipe a day—remarkable speed when you consider that they must cross woods, fields, rivers and swamps. "Unless one has been in the Louisiana swamps," a consulting engineer told me, "it is impossible to realize what they are like. Miles and miles of the softest, stickiest ooze, teeming with half-floating cypresses, and a dense undergrowth matted together with vines and flowing Spanish moss. Our generators were mounted on a skid arrangement called a 'mud-boat' by the natives. Because of its cloven hoof, the ox is famed for its ability to negotiate mud and swamps; and a primitive ox team pulled the mud-boat. But two of the oxen were completely swallowed up by the mire."

**T**HROUGH the completed line swims the "go-devil"—a queer mechanical contrivance you might easily mistake for some huge deep-water nsh. It is thrust into the pipe line at a pumping station, and the flowing oil pushing against its leather gills carries it along the pipe. Knives and notched wheels that it carries loosen the rust and deposits which have gathered within.

Across the field above the pipe line trots a man following the invisible go-devil by the clanking and rattling sound of its knives against the pipe. If the go-devil quits singing, he knows the pipes are clogged; then they are dug up and cleaned.

Behind the present oil line network lies a romantic history. In the picturesque days of the first oil wells, at Oil Creek, Pa., the fluid was transported down the river in canoes and barges to Oil City. There it was re-

(Continued on page 153)



Laying an oil pipe line over the Wyoming desert-prairie from the famous Teapot Dome reservation which is owned by the United States Government. The oil from this field is pumped to Kansas City

# Mind Works Best When Tired



At left: Students answer questions flashed on screen by operator at rear to determine whether minds work better in the morning or at night when they are "fatigue poisoned." They were ten percent better at night. Below: Device recording soundness of sleep as subject's movements shakebed

**Y**OUR mind works better when it is "poisoned." That is the conclusion Dr. H. M. Johnson, of the Simmons Foundation for the Study of Sleep, has just drawn from remarkable tests conducted at the Mellon Institute in Pittsburgh, Pa. His studies, with twenty-one Pittsburgh University students as subjects, demonstrated that fatigue is a sort of poison that first stimulates the brain, then lulls the body to sleep.

Each morning and night the subjects were given mental tests to show how



their alertness varied. At night a delicate instrument like an earthquake-registering seismograph recorded the soundness of their sleep, by noting the motions of the bed when they tossed and turned.

These experiments reversed some long-standing notions about sleep. It has always been thought that "in the morning, when you're fresh after a good night's sleep" is the best time for mental work. But Dr. Johnson's mental tests showed that the students averaged a ten percent higher score at night than immediately after eight hours' restful sleep! In the morning, when your mind is fresh, it is best prepared for a brief spurt, but it is too restless to concentrate.

As the day wears on, "fatigue-poisons, like other narcotic agents such as the derivatives of opium," accumulate in your system. They act as mental excitants, helping the mind to concentrate. For work that demands sustained mental alertness, Dr. Johnson finds the best time is from late afternoon until midnight or later—a striking vindication of "burning the midnight oil."

The longer and "deeper" you sleep, Dr. Johnson's tests showed, the more time it takes to recover from the resulting "flightiness." He finds most persons need a morning walk, a game of golf, or setting-up exercises to fatigue them sufficiently to settle down to work!

## Sixty-Foot Tower Built of Concrete Staves

**A** REMARKABLE sixty-foot lookout tower occupies the highest knoll in Genesee County, New York State, and is constructed entirely of concrete. It was built according to specifications of Don Woodward, who had it erected on his farm to serve as a combination summer house, weather and forest fire observatory, and scenic lookout.

The walls are of concrete staves, fitted together like tiles, and held in place by steel hoops. The roof is constructed of waterproof reinforced concrete.

Woodward has furnished his unique tower with five rooms, one above the other, and has made the entire structure tenantable by installing plumbing, electricity, hot water heat and cooking equipment. His kitchen occupies the ground floor, adjacent to which are the power plant and the drilled well that supply him with hot running water. The dining room is on the second floor, sleeping rooms are on the third and fourth floors, and a recreation room, with lounges, telescopes, and reading table, tops the structure.

The tower stands on the peak of a hill 100 feet high. On clear days Woodward, with the aid of glasses, is able to identify different buildings in Rochester, N. Y., approximately forty miles away.

The tower is equipped with a dumb-waiter, which simplifies transportation from floor to floor and makes it convenient to bring up a dinner from the kitchen and spread it in the observation



The five-story lookout tower of Don Woodward, built of concrete staves on his farm in Genesee County, New York. Steel hoops hold the staves together. The structure has kitchen, dining room, sleeping rooms and recreation room. Dumb-waiter and radio set are other features



Telescope with which the scientific farmer observes weather, planets and distant objects from his concrete hilltop tower. He can identify buildings 40 miles away



"Believe half you see," said the aviator. "The best eyes are fooled by Nature's optical pranks."

**P**HANTOM land, that beckoned Lindbergh on as he winged his solitary course across the Atlantic, added another amazing vision to the long list of strange mirages on record. Aviators and laymen heard the flyer tell, at a recent banquet commemorating his pioneer New York-Paris hop, how, 200 miles off the coast of Ireland, the sight of hills and beautiful trees visible through the clouds rewarded his straining eyes. At last, he thought, he had safely crossed the ocean.

"But a few minutes later," Lindbergh said, "this false land disappeared as quickly and as mysteriously as it had come; and I found before me the long stretch of the silent sea, with not a single sign of life in sight."

Constant companion of explorers and weird mystery to the native populations it visits more rarely, the mirage, through aviation, has become a less awesome and a more familiar spectacle. Flyers voyaging through the vast recesses of the atmosphere tell us of mirages such as that which Lindbergh saw, and of others that would have filled folk of earlier times with dread. By careful observation, they have helped solve many of the riddles that surround these remarkable specters.

Mysterious gray airplanes, shadowlike in substance, have been known to accompany aviators in their flights through the clouds. "Sometimes," an aviator who served with the marines during the war told me, "when my plane emerges from the clouds, with the sun behind me and the upper air clear, I have noticed a sec-

# Mirages—Nature's Own Fakes Exposed

*How Heat, Light and Water Play Tricks to Fool the Eye*

By H. C. NORTH

ond plane thirty or forty yards ahead of me. Though I know it is not real, it never fails to give me a start. For not only does the shadow reproduce my plane to the smallest detail, but it frequently is surrounded by a gorgeous halo of all the colors of the rainbow—one, two, three, and even four circles of colored light about this dusky plane, with the ear as a center. Believe half you see. The best eyes are often fooled by Nature's optical pranks."

Travelers see this same phantom from the tops of high mountains whenever there is simultaneously sun and mist. It is known as the Specter of the Brocken, taking its name from that of the highest mountain of the Hartz chain which runs through Hanover, Germany. There, in the early morning as the sun rises, the mist is blown to the west, and a spectator on the mountain top sees his shadow—a threatening, colossal figure—cast by the sun upon the dense vapors. And round the head of the specter are usually seen colored rings or halos.

Something like this remarkable phenomenon, on a colossal scale, is described in recent reports by Dr. Jean Mascart, noted astronomer at the Lyons, France, observatory. Just as the sun rises, or sets, gigantic shadows of clouds and

mountain ranges have been seen by some observers, apparently cast by its rays on some invisible screen on the opposite side of the heavens. Such shadows of peaks are seen even when the sky is cloudless. Perhaps the screen is a thin layer of floating dust or haze many miles high. It remains a mystery pending further investigation by Dr. Mascart, who has asked ob-

servers of the amazing spectacle to send him further notes.

More easily explained is the Specter of the Brocken, with its huge figures surrounded by halos. The gray figures, of course, are shadows; the colored arcs that surround them are known as glories or diffraction bands. They are caused when light rays, passing near the head, come in contact with the tiny drops of water in the mist. The light is broken up, or scat-

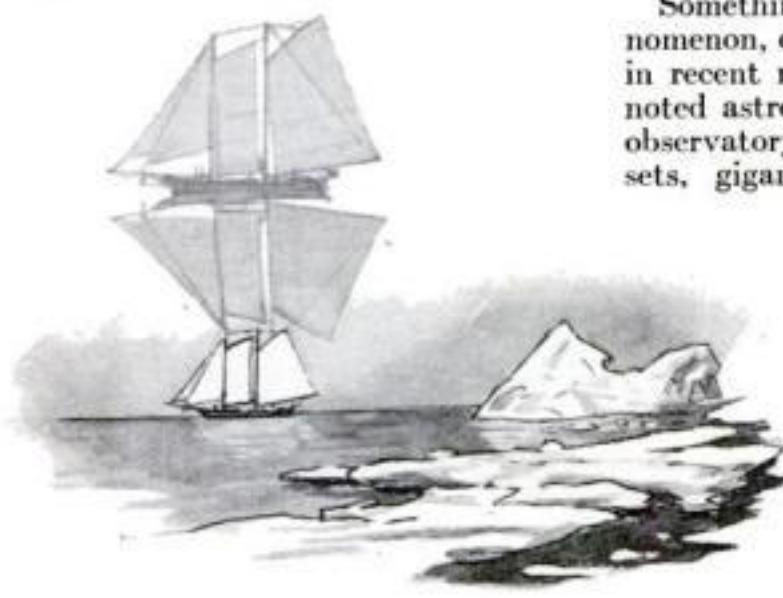


A flyer sometimes sees a phantom plane, "surrounded by a gorgeous halo of all the colors of the rainbow" in four concentric circles

tered, in such a way that when it reaches the eye a rainbow effect is seen. A rainbow, however, is caused by light which is reflected *inside* the drop, while a glory is produced by light which has been scattered without penetrating the surface. The colors you have noticed in mother-of-pearl, feathers, or spiders' webs are a result of that same modification of light.

**I**F YOU want to study a glory, stand with your back to the sun some morning before the dew is off the grass, and look closely at the ground near the shadow of your head. Don't become conceited because you are wearing a halo of colored light.

We may wonder that our ancestors were frightened by such an optical phenomena as the Brocken's, yet every day the most hardened travelers are deceived by those strange antics of Nature, mirages. Even the famous Arctic explorer Peary in 1906 mistook a mirage for what he thought was a new land in



A superior mirage in the Arctic. Warmer air lies between layers of colder atmosphere. Direct light rays show the ship; rays through two layers give the inverted image; through three layers, the erect image



Bending light rays reveal land from beyond the horizon, making it appear like an island set by magic in the bay

the North, which he named Crocker Land. It was not until 1915 that MacMillan and Green discovered that "the faint white summits of a distant land," as described by Peary, were a mirage extending a third of the way around the whole horizon.

The mirage is not an optical illusion or a creation of the imagination. It is caused by abnormal atmospheric conditions which you yourself can produce. The sheet of water the exhausted traveler sees on the arid desert is an actual image which has been photographed. The rays of light coming from the sky to his eye have been bent from their natural straight path, and a section of the sky appears to be on the ground. Since the sky resembles water in appearance the reflection is mistaken for a lake or pond.

**L**IIGHT rays are bent, or refracted, whenever they pass through layers of air of different densities or weights. You have probably observed the phenomenon of refraction thousands of times without giving it a passing thought. For example, when you thrust a stick halfway into water, the portion below the surface appears to be bent sharply upward. The light rays from the submerged half have passed from water to air before reaching your eye. Because water and air are of different weight, those rays have been bent from their normal straight path and that part of the stick beneath the water appears to be where it really is not—a few inches above its actual position.

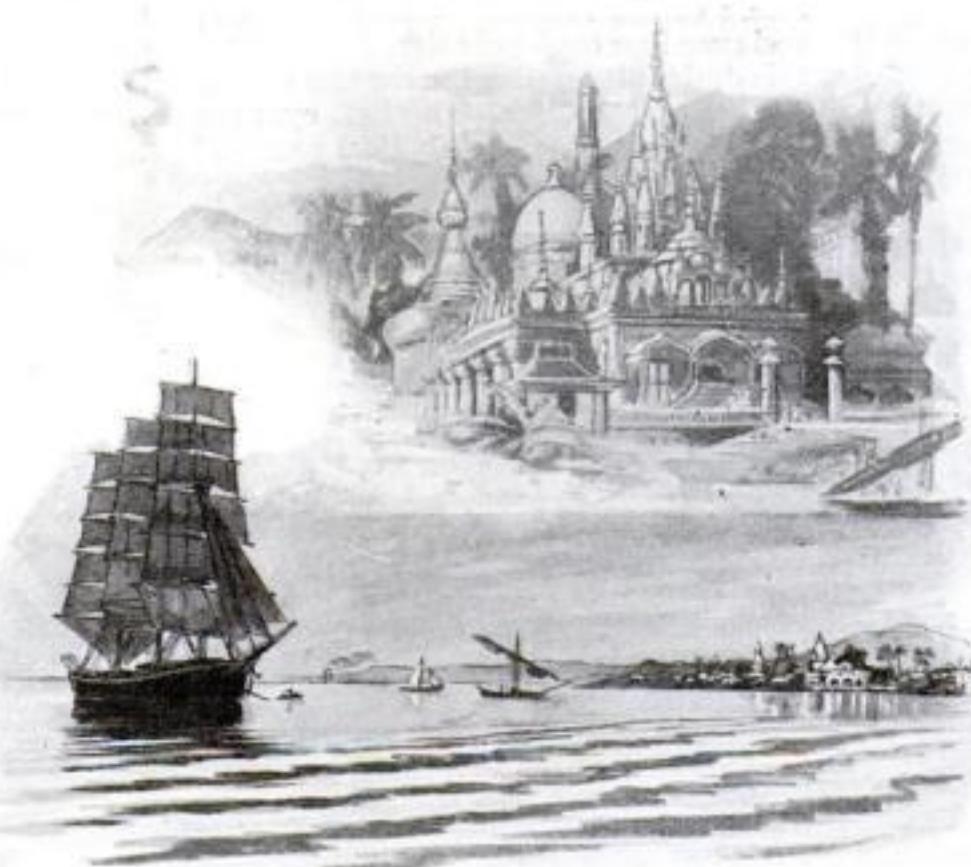
Cool air, heavier than warm air, behaves like the water in the illustration just given. Rays of light passing from one to the other are bent in the same way. That yields the whole explanation of mirages. Whenever peculiar atmospheric conditions exist that produce air layers of widely different temperature, things are all set for a mirage.

On the desert, for example, the hot sand causes a shallow layer of intensely hot air. Above, the air is normally cool. And the wanderer perceives distant trees that rise above the horizon mirrored as inverted

images in what appears to be a lake, but is actually the sky. He sees the trees, and the sky, twice—once by direct vision, and again by other rays that would ordinarily strike the ground but are bent upward again by the warm air layer. The last set are the ones that produce the "lake" and its reflections.

Professor R. W. Wood, of Johns Hopkins University, constructed an apparatus to produce such a mirage in his laboratory. A flat sheet steel surface is sprinkled with sand to prevent reflection. At one end

a mirror, mounted so that it comes down to the level of the sanded surface, reflects the sky to an observer at the opposite end. In front of the mirror a cardboard chain of mountains is placed.



Fata Morgana, famous mirage of the Sicilian coast. Rays through many irregular layers of air of various temperatures rear beautiful castles in the air

When the small "desert" is heated with gas jets beneath it, one can see what appears to be a glittering pool in the sand, in which are reflected inverted mountains. The gas-heated layer of air near the surface, with the cool air above, acts in the same way as the sand-heated air of the desert.

**C.** R. ENOCH reports a most unusual and deceptive desert mirage in Bechuanaland, South Africa. It is a land of considerable elevation—some 4,000 feet above the sea level—covered by expansive inland lakes in time of flood. In the dry season the water disappears, leaving only a baked plain. But to the unwary those lakes still exist.

You are almost sure to see a mirage on cold autumn mornings over a large body of water. In the fall the water retains the heat from the sun throughout the night, and in the morning after a clear night, it will be several degrees warmer than the air. Consequently a thin stratum of adjacent air is heated above

the normal temperature, giving the same conditions as observed in a desert mirage.

If you are near a lake on some crisp morning, look at objects on the opposite shore, with your eyes not more than three feet above the level of the water. Almost immediately you will be aware of a slight quivering of the trees and landscape, and then some of the objects will seem elongated and appear to dance. The motion is due to slight variations in the heat which bend the light rays irregularly. The elongation is really an indistinct double image, that we know now is caused solely by the pranks of the heated air. If you can detect in this elongation one upright true image and one inverted image, you have seen an inferior mirage.

The mirage observed in Arctic regions is known as the "superior" mirage. In 1906, A. H. Harrison, explorer and author, saw above the clouds in northern Canada a camp apparently pitched on the top of a mountain. The camp, around which his telescope disclosed several dogs, was upside down! After traveling toward it for half an hour, he found an Eskimo camp—it was the camp he had first seen inverted in the air.

**E**XPLORERS often see mountains upside down in the sky, the peaks of the inverted range touching the true mountains; sometimes an upright image of the range is super-imposed; sometimes it is not visible. Ships sailing Arctic seas are frequently seen three times. The real ship is beheld with two ghost ships in the air above it—all in contact. The first phantom is upside down; the topmost is erect.

When warm air passes over frozen seas or ice fields, it becomes sandwiched between two layers of cold air, and the Arctic mirage just described arises. Rays of light passing through these zones—cold air above, warm air be-

tween, colder air beneath—are bent toward the earth. The ray of light meets tougher going when it hits the denser air and bends (Continued on page 168)

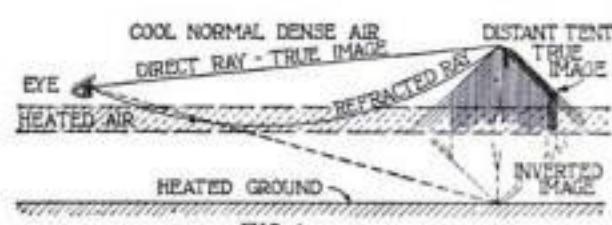


FIG. 1

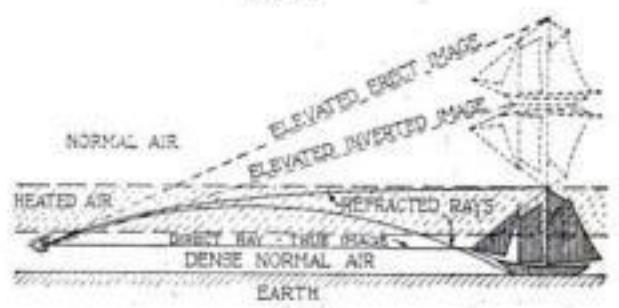


FIG. 2

Inferior desert mirage (Fig. 1), caused by rays through two strata of different temperatures, and (Fig. 2) Arctic superior mirage, produced by rays refracted through three different air temperatures

# Bridges Built Of Magic Dust

## Rock Blasted to Powder and Baked in Volcanic Heat to Make Cement

By EARLE DUFFY

**T**AWN, sweating Egyptians, tugging and hauling until great knots stood out on their foreheads, spent scores of years in building each of the gigantic pyramids. Through the magic power of Portland cement, American concrete builders of the twentieth century could with ease erect thirty-five stone mounds each the size of the famous Cheops, largest of the pyramids, in a single year.

This is indeed the Concrete Age. Mammoth dams, tall buildings and bridges with arches more than 400 feet wide, may be built almost in the twinkling of an eye as compared with the rapidity of building even a century ago. Appius Claudius, Julius Caesar and other prominent good roads boosters of bygone days would marvel at the vast mileage of smooth highways now constructed each year.

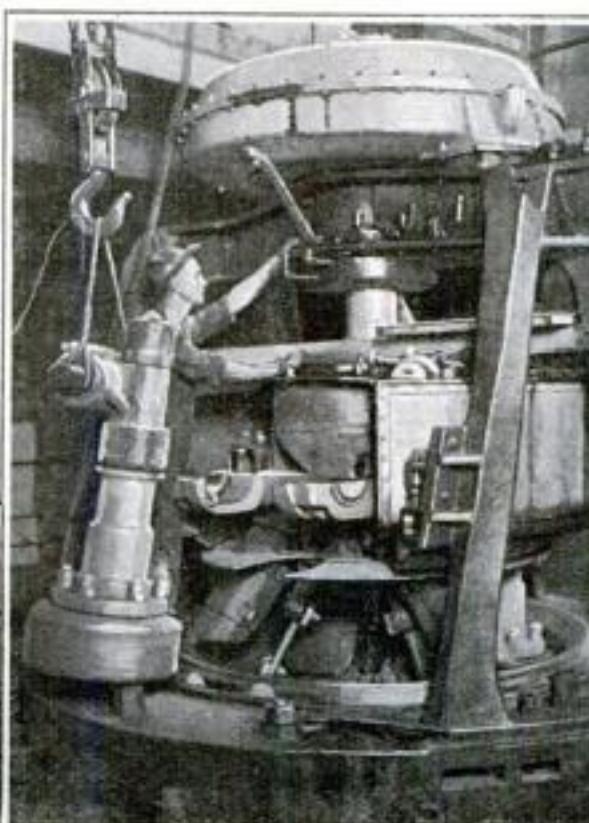
**W**ITH concrete on every side, most of us do not know that its tremendous power is given by a powder finer than flour or talcum. When Portland cement, commonly called cement, is mixed with sand and stone in the right proportions, the mixture becomes concrete.

But what is this Portland cement?

A form of cement was known six thousand years ago, historians have every reason to believe, yet the cement now commonly used is scarcely a hundred years old. Carthaginians created a crude cement mortar for use in building aqueducts, whose remnants still stand. The Romans molded concrete into foundations for many of the Forum structures, and in Pompeii excavations have disclosed well preserved concrete walls.

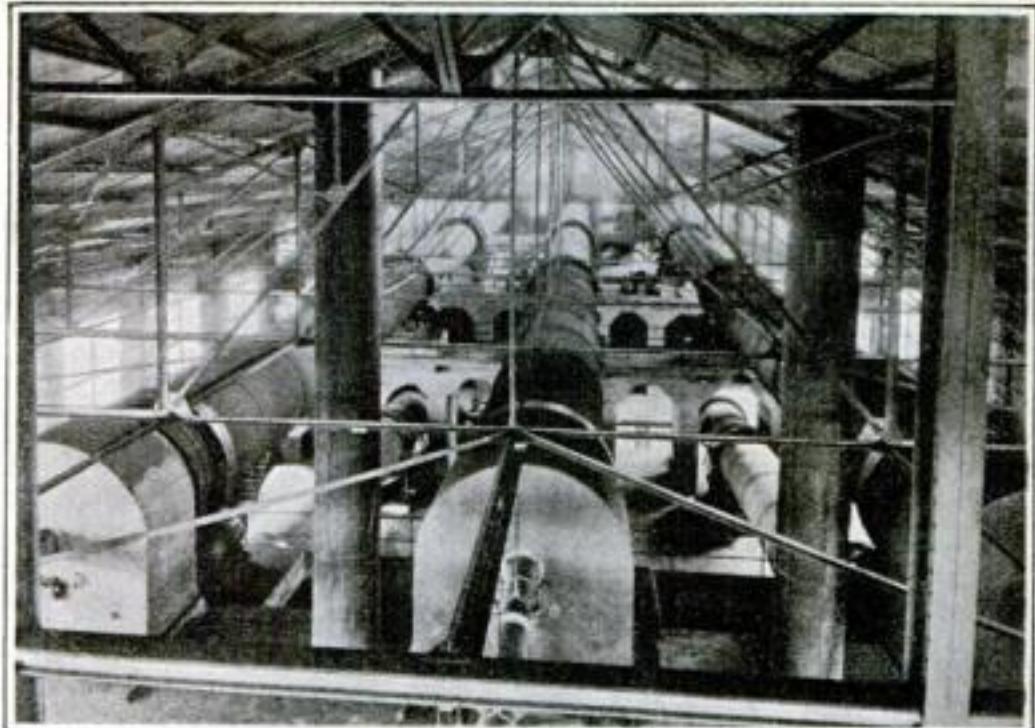


At top: Burned cement dropping from kiln at end of its treatment. In oval: Sieve with 40,000 holes to inch tests cement's fineness



A mill to grind rock for cement into sand. Three hammers like that in the foreground rotate after a steel jacket incloses the mill

Interior of pulverizing mill. As it revolves, the thirty tons of steel balls at the bottom are lifted and fall, beating the rock to fine powder



The world's largest blowtorches—Portland cement kilns. The giant steel cylinders, more than 300 feet long, turn once every ninety seconds as the cement inside is burned in hundreds of degrees above volcanic heat

The Romans gathered ashes cast from the vomiting Vesuvius and mixed them with burnt marble, obtaining a fair cement, before the coming of Christianity.

Modern cement makers have profited by the teachings of Vesuvius. After centuries of experimentation, man discovered that he could make his own volcanoes which would accomplish better results than the furnace of Nature. So today powdered raw cement materials are blown into huge rotating kilns where they are burnt at temperatures of 2,700 degrees to 3,000 degrees, Fahrenheit—temperatures hotter than necessary to smelt gold, silver and copper. These horizontal kilns, which may be as long as 340 feet and thirteen feet in diameter at the burning end, are the largest pieces of moving machinery in all industry.

Portland cement is a highly manufactured product, the result of eighty-odd distinct manufacturing operations.

**T**O CREATE cement, whole hills of solid rock, containing the needed lime, silica and alumina are blasted loose and reduced by giant gyratory crushers and then smaller ones to fine powder.

The 164,000,000 or more barrels of cement produced in 1926 weighed some 30,000,000 tons, yet to produce this vast amount approximately 50,000,000 tons of limestone, shale and slag were needed, for in burning the materials more than a third of their weight is driven off in the form of gases.

In the final powdering process the tube mill, one of the most peculiar machines in all the fantastic cement industry, is used. The tube mill is a large horizontal steel cylinder partially filled with steel balls of five eighths to one and a quarter inches in diameter—in one mill the balls may weigh thirty or forty tons, an average freight car load. As the steel cylinder rotates these balls climb up the sides and cut other capers until the sandy particles are pulverized.

But the process so far has been that of preparation only. The important step in manufacturing cement is now to be taken. The various

(Continued on page 155)



# Solving Riddles of the Universe

## Windmills Generate Current—Electric Plow Destroys Pests—Other Startling Discoveries

Important steps in the progress of science in varied fields of invention and research which are of special interest because of their bearing on everyday life are chronicled from month to month in these pages.

### Windmills Give Electric Power

THE use of windmills to generate electricity for farms remote from main electric supply lines has been proved practical in recent tests by the Oxford University Institute of Agricultural Engineering.

If the windmill is placed in the free path of prevailing winds and supplied with storage batteries to act as substitutes on calm days, we are told, the farmer can have his own up-to-date generating plant. As an auxiliary to charge the batteries, an old engine no longer fit for regular running may be used.

The tests showed that the cost of windmill-generated electricity compares favorably with that of service from power companies.

### Steel for Paving

FUTURE streets of great cities like New York and London may be paved with steel plates. The idea recently has been proposed by engineers to save periodic repair, which, as cities grow larger and busier, becomes more costly and troublesome. Only recently one of London's main streets, a part of Piccadilly, was closed for repairs, with vast annoyance to Londoners. Three summers ago New York went through a similar annoyance when Fifth Avenue was closed.

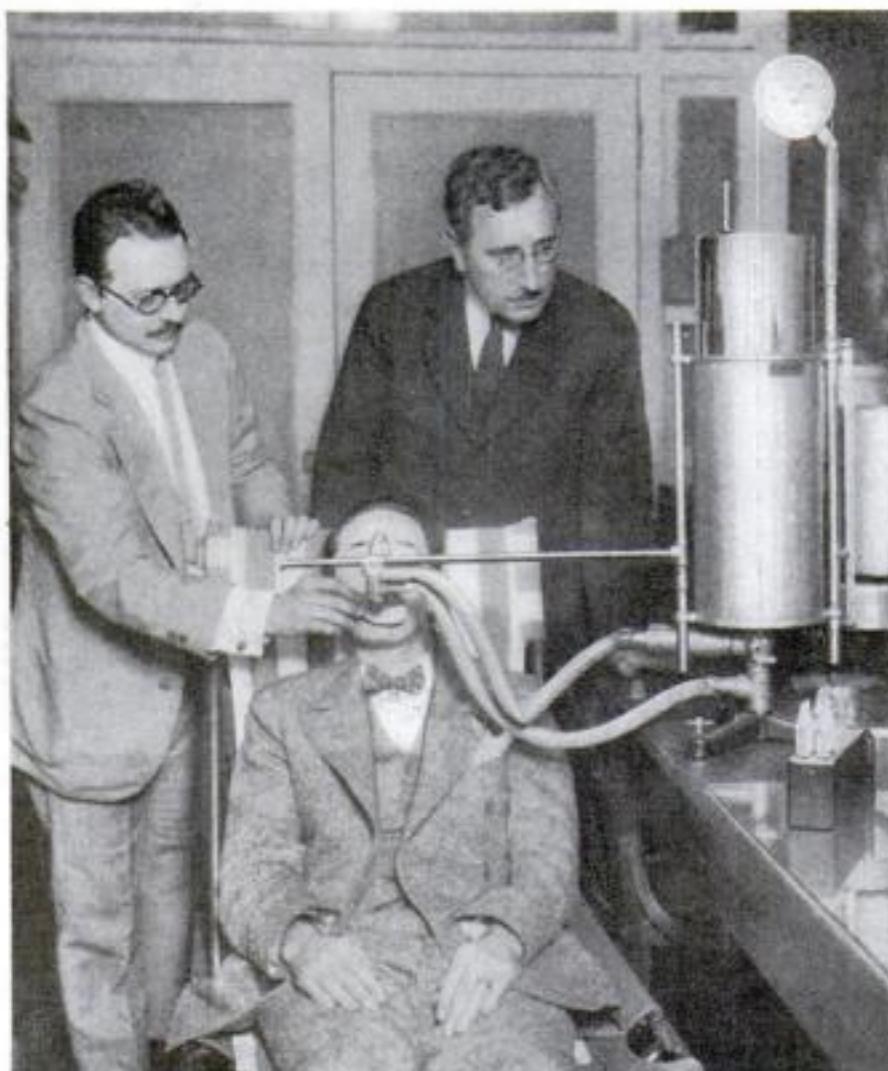
Experts point out that since rubber now has largely replaced metal for vehicle tires, steel would perhaps be the ideal surface. Pipes and electric lines could be laid beneath removable plates, thus saving the cost of digging up streets.

### Gains in Medicine

HERE are notable health advances of the month: After years of experiment, Dr. Charles W. Duval, of Tulane University, claims to have exposed the germ of measles and promises serums to prevent and



By the substitution of aluminum plates for the copper ones with which engravings formerly were made, the U. S. Geodetic Survey has simplified and accelerated map making. An operator is shown engraving a map on a sheet of aluminum, which serves as a plate from which any number of copies may be made. The copper method is more tedious



The trouble with people who stammer is not in their tongues, but is caused by the failure of their lungs to abstract sufficient oxygen from the air they breathe, according to Professors E. B. Twitmeyer and H. E. Starr, University of Pennsylvania psychologists, who are shown making one of the tests that they declare prove their contention. Measuring oxygen in air from a tank before and after the subject breathed it, they find his lungs did not retain normal amount of oxygen

cure this oftentimes fatal disease.

In Germany, Dr. Carl Rabl announced a new method of straightening crooked bones of babies by softening and bending them. The new treatment calls for special diet and freedom from sunlight until the bones are soft.

Dr. William Hunter, English neurologist, offered proof that insanity often is caused by neglected and decayed teeth. Dr. Harry A. Goldberg of the Dental Department of Mount Sinai Hospital, New York City, added evidence that chronic infections of the roots of teeth produce serious nervous disorders.

Treatment of more than a thousand cases of cancer in the Memorial Hospital, New York, has convinced medical authorities of the efficacy of a new radium method of combating the disease. Minute gold tubes containing radium gas, or radon, are implanted in the cancerous growths. High frequency gamma rays from the radon cause the growths to shrivel and stimulate healthy tissue.

### Ants as Nurses

WHILE studying ant hills recently near Baltimore, Prof. E. A. Andrews of Johns Hopkins University discovered that ants sometimes move their babies from the colder to the warmer sides of the ant hills.

Thrusting thermometers into the sides of the ant houses, he found that the inside was warmer than the outside air; and, since the sun was the only heating plant, the southern sides of the hills were warmer than the northern. Twice he watched processions of ants carrying unhatched infants from a northern to a southern side.

Apparently insect parents know the value of warmth and sunshine for children.

### Television Opera

AMAZING phonograph records that will enable us not only to hear but to see entire plays and operas in the home, are a promised development of the new Baird television process described in the September POPULAR SCIENCE MONTHLY.

This development, recently forecast by Sir Edward Manville, Chairman of the Baird

Television Development Company, consists in recording on phonographic records, similar to ordinary musical records, a series of grooves. These indentations represent a series of electric impulses corresponding to the spots of light and shade in the visual scene being reproduced. When the television record is run off, its indentations, passed through the receiving apparatus of the Baird television, are expected to reproduce on a screen the sight originally recorded.

The process, according to Sir Edward, is still in the experimental stage.

### America Found 1000 B.C.?

**A**MERICA may have been discovered by primitive Europeans thousands of years before even the Norsemen came.

That fascinating possibility presents itself as the result of examination of a mysterious bronze ax found at Brantford, Ontario, by Dr. M. R. Harrington of the Museum of the American Indian, New York City. The implement was obtained from an old Indian, who said he found it buried. Although it resembled weapons in use at the time of the Norse visits to America, about 1000 A.D., Dr. Harrington's examination proved it belonged to a far earlier period. Experts of the Museum believe the ax dates from the late Bronze Age of Europe, perhaps about 1000 B.C.

### Building Spires Doomed

**W**HEN someone expressed surprise to Lieutenant Bernt Balchen that while he was piloting the giant monoplane *America* through hours of storm over Paris, looking for a place to land, he could not see the Eiffel Tower, the Norwegian flyer replied:

"See it? I didn't want to see it!"

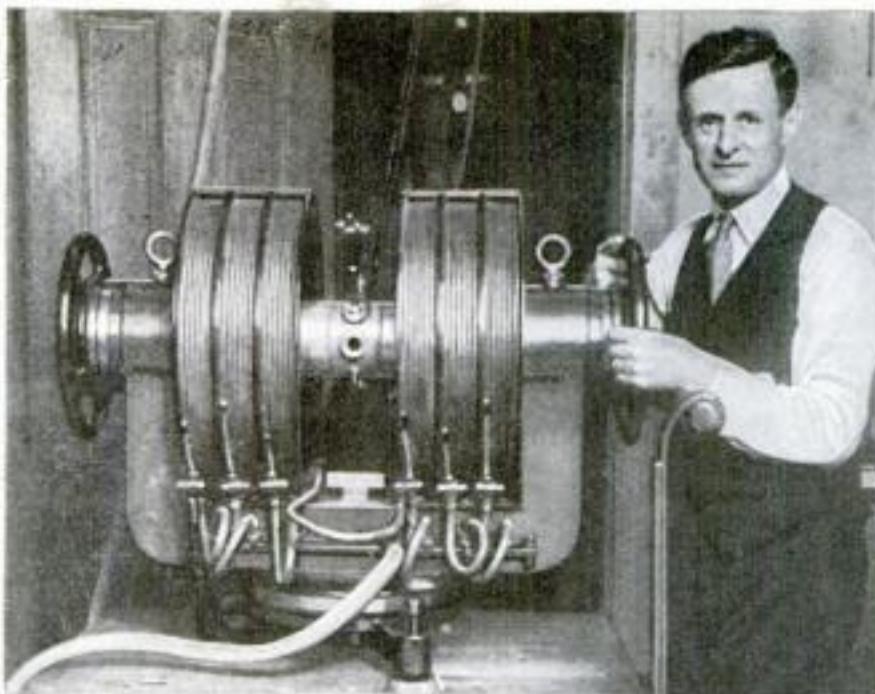
In that statement, say architects, lies a prophecy of a revolution in building design—a direct result of aviation. Loft towers with pinnales and spikes, dangerous to aviators, will be replaced by flat-topped roofs suitable for landing fields.

An example of this trend is the design for the proposed Chicago Post Office, which calls for a great flat roof 320 by 800 feet.

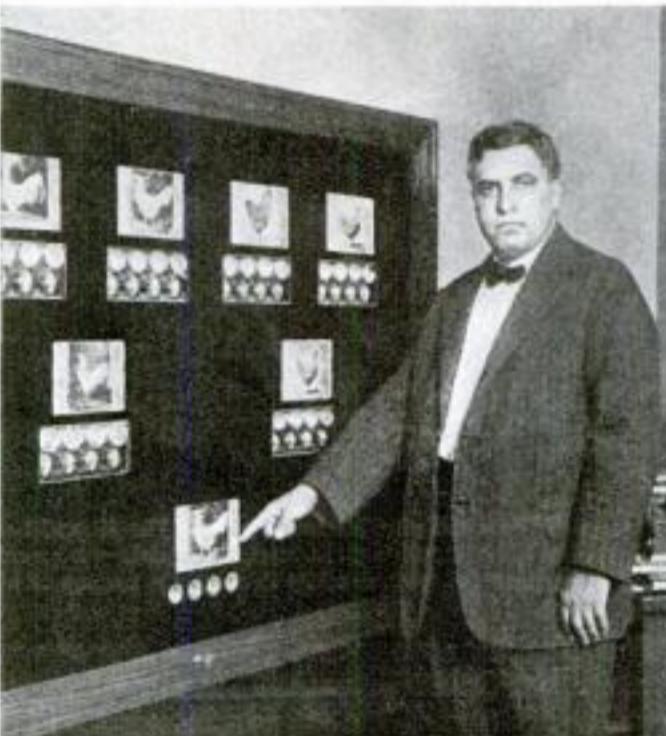
### Electric Plow Kills All Pests

**A**T THE Donald Woodward farms, near LeRoy, N. Y., unprecedented crops are said to have resulted from an "electrical plow," invented by Hamilton L. Roe, of Pittsburgh, which not only destroys weeds and insect pests but enriches the soil by fixing nitrogen in the ground. Roe believes it will replace fertilizer.

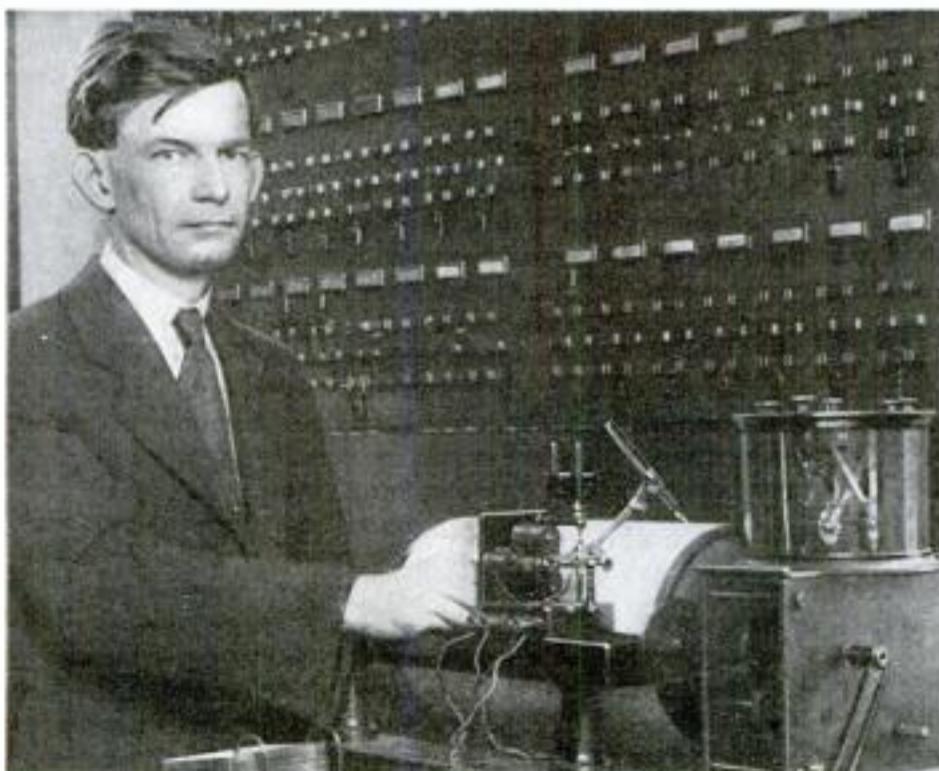
The plow, attached to a tractor, is fitted with an electric gener-



The mystery why magnetic force bends rays of light may be solved by Dr. W. F. Meggers of the U. S. Bureau of Standards with his huge electromagnet. Its two coils make an intense magnetic field in which sparks are made between various metals to be studied by a camera and spectroscope stationed in an adjoining room. To keep it cool, its copper windings are made hollow and water is kept running through them in the experiments



R. R. Graves, U. S. Department of Agriculture, illustrates the inheritance of traits by domestic fowl. The top row represents two pairs of ancestors; the next, their offspring; the next, the grandchild. In the little cups under each square, colored balls indicate the hereditary traits



Paul Sollenberger, time expert at the Naval Observatory, Washington, who sends out the official time signals, is shown above with his apparatus. The cylinder indicates the time required for signals to travel to various points. Governed by these figures, he operates the switches shown on the board, so that, despite their varying distances, all points receive the signal at the same instant

ator, coils and other apparatus, which are connected with two plow blades. "As these blades pass through the soil," says the inventor, "an electrical field is created between them, producing an effect like lightning."

"In the first plowing the current has a deadly effect on pests. A second treatment kills weeds and fixes nitrogen into the soil."

Further tests will compare electrically treated crops with crops grown under the best conditions known to scientific farming. If the new method proves practical it would save millions of dollars now being spent to fight insect pests.

### New Use for Vacuum Tubes

**V**ACUUM tubes, developed primarily for radio, are now finding a new use—synchronizing, or keeping in step, widely separated power generators.

At present many isolated power plants throughout the country are consolidating their resources in great central organizations, thus effecting economies in operation and permitting the service of large territory from a single system. To make it possible for the output of different plants to be pooled in a common supply, vacuum tubes are employed. If the incoming machines are running too fast or too slow, the alternating current will be out of step. The vacuum tubes amplify this error sufficiently to operate an instrument called a synchroscope which shows exactly how far the new current supply is out of step with the main system.

Previously the synchronizing of a group of stations was accomplished by potential transformers, an expensive method compared with the new system.

### Testing Food by Color

**C**HEMISTS are rapidly answering the old and often violently argued question of how much good we get from various kinds of foods. Their latest project is to determine the body-building properties of any given food by color tests—that is, by the color produced in the presence of certain chemicals.

For example, Dr. Stanley G. Willmott and Frank Wokes of Cambridge University, England, have found in prolonged experiments that antimony trichloride produces a beautiful blue in the presence of vitamin A, the food substance needed for body growth. In these experiments they used a delicate color measuring instrument called a tintometer.

Heretofore the method of measuring the value of such foods as cod liver oil has been the tedious one of feeding it to animals and observing their growth.

Chemistry soon may make it possible, when we buy food, to know how much real value we are getting.

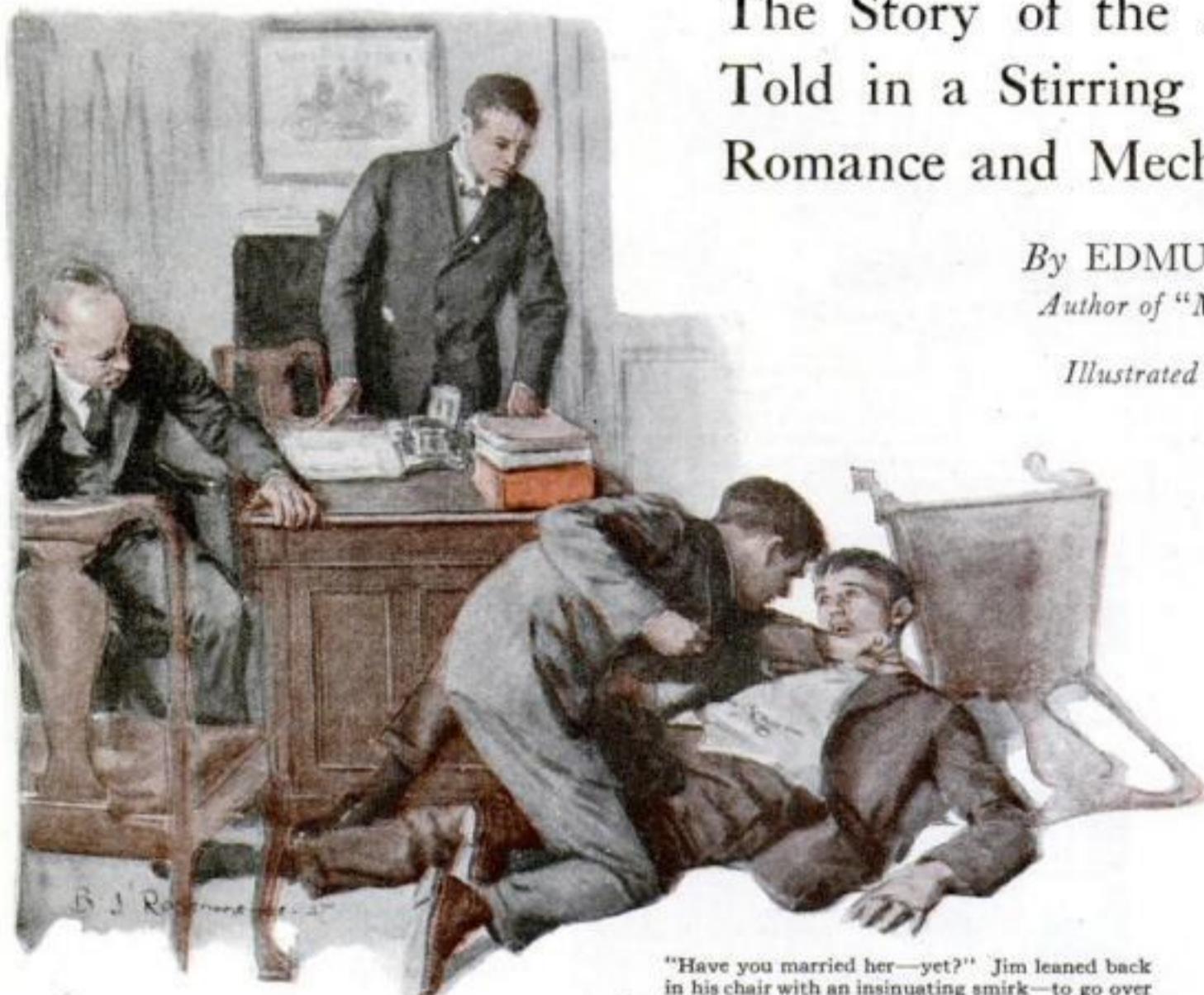
# Whirling Wheels

The Story of the Automobile Age  
Told in a Stirring Novel of Youth,  
Romance and Mechanical Ingenuity

By EDMUND M. LITTELL

*Author of "Midge" and "Fire Shy"*

*Illustrated by B. J. Rosenmeyer*



"Have you married her—yet?" Jim leaned back in his chair with an insinuating smirk—to go over backward with a white-faced fury on top of him

THE feud between Gil Herrick and big Jim Wenden was a contest for speed and supremacy combined with bitter rivalry for the hand of a beautiful girl, Gail Caswell. It started back in 1895 when Gil, a young mechanic, arriving in the village of Wendenville, Mich., found lodging in the Caswell home, set up a bicycle repair shop, and began to build a motor wagon. Gil first conquered Jim in a bicycle race and was rewarded by a bunch of flowers from Gail. Later, when Jim won a motor wagon race between the two, Gail ignored him. And when Jim tried to steal a kiss, Gil interfered. In the struggle that followed, Gil fell unconscious, his arm broken by the bigger man.

Gail confessed her love for Gil. But Mrs. Caswell, who preferred Jim, induced the girl to move to Boston. At parting, Gil and Gail agreed to be married soon; but four years passed, during which the young mechanic worked to perfect his motor wagon, while the girl's affection was slowly undermined by Mrs. Caswell's wiles and by visits from Jim, who had entered the motor wagon business in New York.

At last Gil moved to Detroit, where he established a small runabout factory in an old carriage shop. And in November, 1900, he drove his runabout to New York to exhibit in Madison Square Garden. But his hopes for recognition were blasted when a deal with a New York business man for twenty cars fell through and the public failed to buy. Gail wrote that she and her mother were sailing for Europe. And to cap the climax, Gil learned that his plans for a new four-cylinder car had been betrayed to his old rival, Jim. Just when the future looked darkest, Gil met two young men, Andrews and Morton, who agreed to take fifty runabouts and referred him to a friend who planned an agency in Boston. Gil wired Gail: "Better unpack your bags," and drove to Boston. But there his plans were delayed. When at last he reached the hotel where Gail was stopping, she repulsed him, accusing him of neglecting her, and refusing his plea that she remain with him.

Stung by her words, Gil sought refuge in his work. He had

orders for sixty-five runabouts, but was in desperate need of working capital. Jim, arriving in town, undermined his credit and Gil's little business seemed about to go under. By a clever ruse, however, he won the confidence and financial backing of Mr. Oliver H. Marston, a hard-headed banker. He was cheered, too, by a message from Gail in Europe, saying that she was "sorry."

As yet there was little public demand for cars, however, and Gil was forced to close his shop, although his 1902 and 1903 models embodied vast improvements in design. At the automobile show of 1902 the crowds were discouragingly indifferent. But the

next year, in the show of January, 1903, the public suddenly awoke. Business began to boom. The Age of Motors had dawned. Now read on:

AFTER the doors closed that first night in Madison Square Garden—who will forget it? The crowd gone, none but players of "The Game" there—and bedlam. Many a throat was sore next day, many a man spoke in husky tones; for such a shout went up—and stayed up—as was never heard on any football field. Men who had labored celebrated, intoxicated by success, and heedless of the terrific job that impended—production.

Gil was there, shouting madly. He had felt it coming, even though he had produced only sixty runabouts the year before. So were Andrews, and Morton—and Jim Wenden. But they all loved everybody that night. The Game! No players ever played a game more earnestly than those merchants of speed; no men ever played it more squarely. Fight? Of course! For the joy of the Game. Quarrels? Of course. For the heat of play made them. But just then—they all loved everybody.

"I told you!" screamed Andrews, and he seized Gil by the shoulders while they both danced a jig. "I told you! A thousand cars for us this year!"

Morton, too, joined the ring. "Thousand?" he yelled as they made a war dance of it. "Two thousand, you mean!"

And Gil, as drunk as any man on the wine of promise, out-yelled them both. "Five thousand!" he bawled, and desecrated the handsome back-entrance tonneau of his two-cylinder car with a pair of dusty feet. Why not? He had made it.

"Five thousand?" repeated Andrews when sanity had come. "What do you mean, five thousand?"

And Gil laughed. "Well, maybe I stretched it a leetle, as Mac would say, but I'm shooting for twenty-five hundred at least."

Stock all sold, some of it to old Zach Wenden and some good friends in Wendenville; money in the bank, the shop already

going full blast—and news from Gail. No wonder he acted like a drunk man! What mattered it if Jim Wenden had a four in a booth not twenty feet away? Or what if the most recent news from Gail had come through Jim?

"The shop's already lined up to make a thousand," said Gil. "I felt it coming, this rush. That reliability run last fall. And I wired Mac today that he's got to double it. Tomorrow I'll wire him to double it again."

That was too much for Andrews. "And where are you going to sell 'em?"

Gil winked a cocky, knowing wink. "That'd be telling," said he. "Jim Wenden's too close by. I'll be getting a wire any minute now—and then you watch my smoke."

"Ah-ha-a-a!" cried Morton to Andrews. "We're about to have a rival! Another agency, eh? Now look here, Gil: if you don't keep us satisfied we'll—we'll leave you for Jim Wenden!"

**N**O WORSE threat could have been made; he knew it. But he did not know that big Jim Wenden heard.

"An' that'll be the best thing you ever did, boys!" came Jim's heavy voice. "Better come along; he's an unlicensed manufacturer and he's gonna flop, sure. What's this about an agency, Gil?"

"You'd like to know, wouldn't you?"

"I do know. Fosdick, Chicago."

Here was a matter between two men, and Andrews and Morton stood back, noting that Gil's hoarse voice was jaunty, unafraid; unangered, cool—even toward Jim Wenden, whose car, motored with an engine of Gil's own design, was standing over there.

For Jim had told him about Gail—braggingly, of course, and flourishing a letter postmarked "Venice." Mrs. Caswell had written it, reporting that Gail, having suddenly decided to return, was planning to arrive in Boston some time during that very week; and asking if Jim would arrange to meet her.

No, Gil could not be mad at Jim, for Jim had wired her that he would go up the following week, that the show would detain him. As though Gail would wait—for Jim! She would be coming on to Gil; he knew it.

"You know everything, don't you?" said Gil.

"Sure," Jim preened himself a little. "Think a man like Fosdick is goin' to turn all his agencies loose on a car without looking at mine? Ha-ha!"

But there was another thing Jim did not know. Fosdick was being trailed by Wally Burns. It was Wally who had passed along the tip to Gil; it was Wally who was probably even now buying George Fosdick a supper somewhere after the theater; it was Wally who had met him by way of the 1902 model, and was pressing that advantage. Wally was even planning to come to New York with that most valuable prospect.

"Aren't you clever, Jim? But what's he going to say when I tell him I designed your four?"

But Fosdick did not come. Instead, both Jim and Gil received identical telegrams. They knew, for they compared them.

"Unable come New York meet me Congress Annex Chicago Sunday."

"That makes it nice," laughed Jim. "We'll talk it out together."

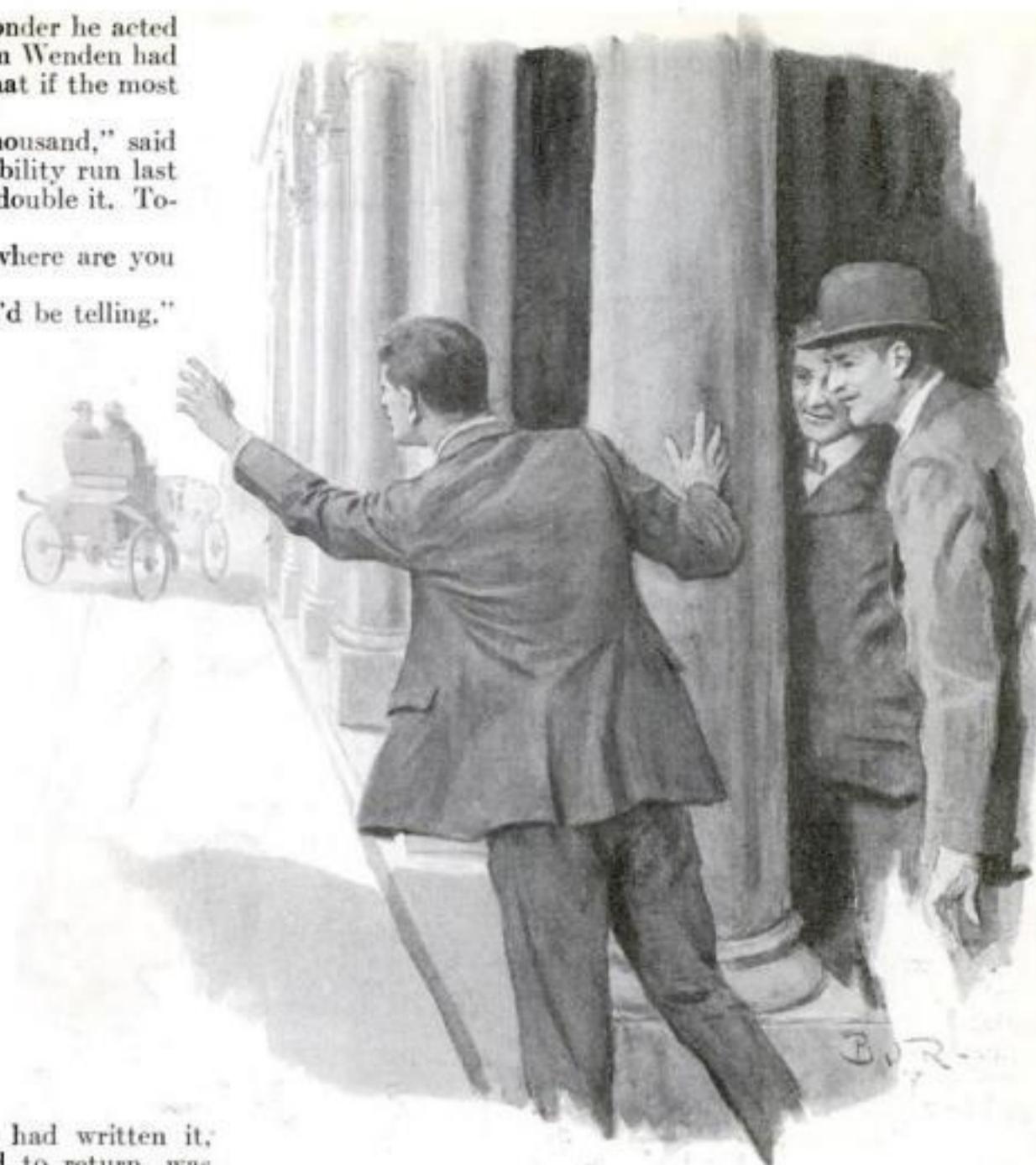
"We will not," said Gil flatly. "We'll fight it out—separately. You're going to remember those cute remarks about fly-by-night manufacturers before I get through with you."

**A**FTER which, in a corner of the booth where they could not be observed, he showed Andrews and Morton a wire that was none of Jim's business.

"Leave Friday Twentieth Century can fix meeting Saturday. Wally."

"Which, with this little stunt that a blunder-head would never think of, ought to put us in pretty good shape," said Gil, and showed them a message he had scribbled on the back of an envelope. It was addressed to Mac, and instructed him to ship a 1903 model by express to Wally in Chicago. "If Fosdick can't come to the show, we'll take our part of it to him."

"Great stuff!" in a breath, from Andrews.



Jim dashed out after her, just in time to see Gil and the girl scramble into the tonneau, even as its wheels began to turn, and drive away

From that moment, every move Gil made was under observation by Jim or his men; even on Friday, when a demonstrator waited at the curb outside with Gil's handbag hidden under one corner seat of the tonneau, and Gil was finishing up a last discussion.

**T**HINK it over carefully," he was saying to the partners. "I need you in Detroit. I'm going to be too busy manufacturing and experimenting to take any time off for selling."

"But you don't need any sales managers," insisted Morton. "Not when you can pull a stunt like this one."

"This is the last," Gil declared. "And you'll have a territory as big as the world; don't forget that. Gosh! Only thirty minutes to train time!"

He and Andrews slipped on their coats and went out, walking past Jim's booth. "Going to lunch, Jim; join us?" Morton heard Gil say, and had a silent chuckle. Jim had lunched more than an hour before, and Gil knew it. Clever boy, Gil. Morton watched them disappear down the aisle—and heard a feminine voice.

"Is this the Herrick booth? Is Gi—Mr. Herrick here?"

He turned, and faced a lovely young woman whose blue eyes beneath her picture hat were glowing with eagerness. "I'm sorry," said he. "He's just left. Is there anything I—"

"But I must see him; right away! He knows I'm coming. I came all the way from Boston, and—"

"Oh!" Morton's eyes widened. "From Boston! Well, if you hurry you can catch him. Down that aisle. You'll find him climbing into a tonneau—if you run!"

She was gone—and a shout: "Hey! Abby!" rose behind her. If there was any doubting whose voice it was, there was no missing the bulk of big Jim Wenden, who dashed out after her. And booth or no booth, sale or no sale, Morton chased out behind.

He was through the door a step behind Jim, just in time to see Gil and the girl scramble into the tonneau, even as its wheels began to turn. Each of them smiling into the other's eyes with



The factory was junk; the machines covered with charred timbers. Gil turned to Gail; close beside him: "Gail, dear, this isn't going to be much of a honeymoon!"

no ear and no concern for the shout Jim raised behind them.

"Where are they going?" demanded Jim excitedly. "What's he doing?"

Andrews dragged his eyes away from a pleasant sight. "Why," he drawled with a devilish grin, "I gathered he was going to take her for a ride. That's what she asked him to do."

Then both partners watched the tonneau of a car disappear around the corner, carrying a couple who sat looking at one another with such a light in their faces—until a messenger boy broke through their abstraction.

"Mr. Herrick? Well, where is he? Got a wire for him."

Morton took it, and after one of those glances at Andrews, opened it. "Good Lord!" he whispered and passed it over. It read:

"Plant burned down last night total loss.—Macintosh."

\* \* \*

"—And speaking of unlicensed, Gil—have you married her yet?"

Nobody but a Jim Wenden would have said it; no one but the big man whose dark eyes leered suggestively, who was sure now that he had won. Jim had seen the accepting, deciding look in Mr. George Fosdick's eyes; that gentleman had listened to the summation of each of them without a word. And then Jim had added that question, leaning back in his chair with a smirk—to go on over backward with a white-faced fury on top of him.

It took the combined efforts of two men to separate them. George Fosdick, being a sizable chunk of a man himself, grabbed Jim by the coat tails; Wally Burns seized Gil. And when the two combatants had been calmed, Jim mopping a bloody nose and Gil quite unconscious of a blackening eye, Mr. Fosdick spoke.

"This looks like a mighty poor way of going after a contract," he announced, and his round, fat face was serious. "Suppose we have it out right now."

"I'm sorry," said Jim from behind a reddening handkerchief. "I shouldn't have—"

"You're too late," snapped Gil, his face still white and glaring at his enemy. "You said it. And if I ever hear of you making that remark again, I'll murder you if I hang for it!"

"Aw, listen, Gil; I—"

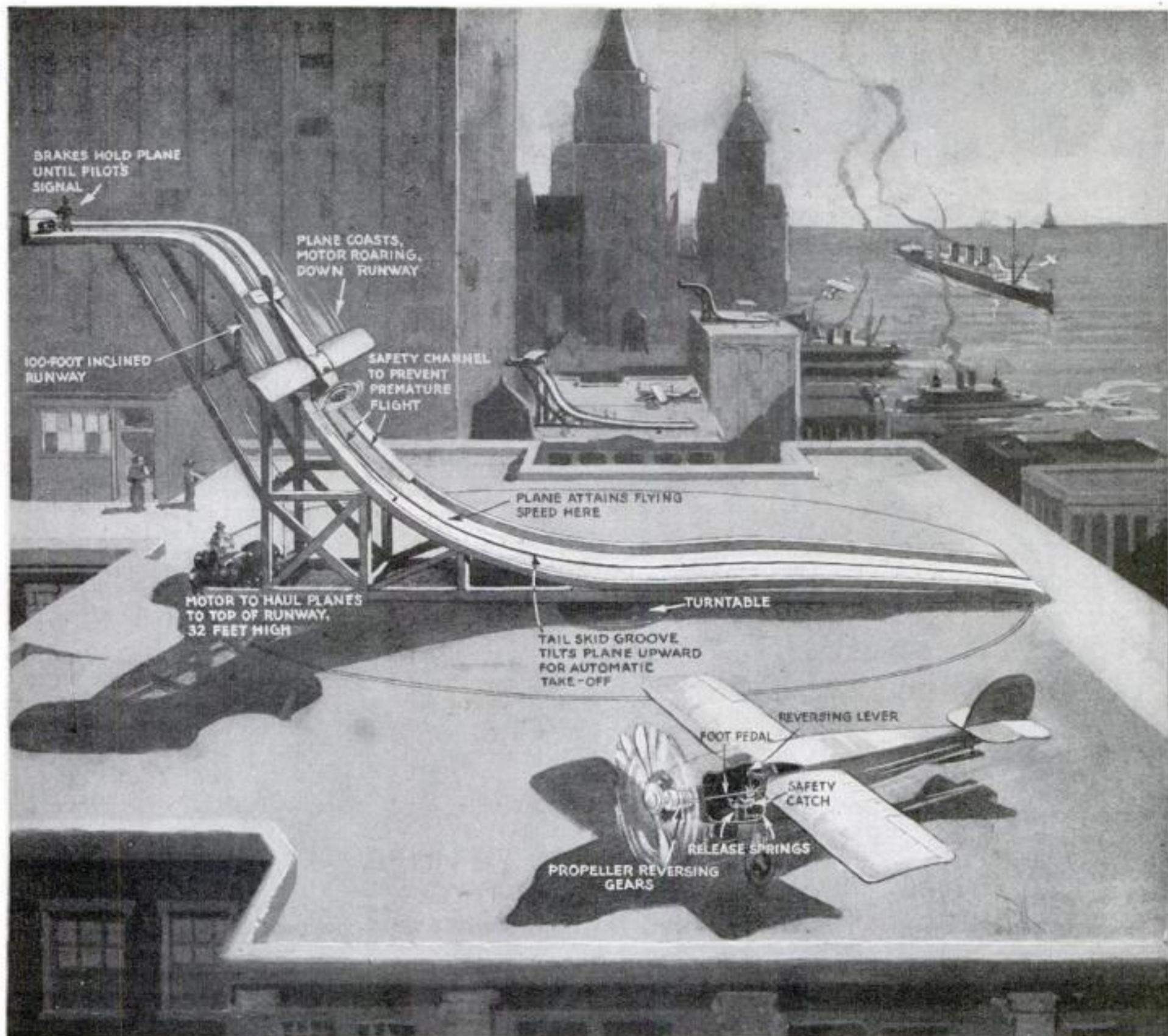
"I'm done listening to you!" and Gil turned to Fosdick. "This black-hearted, back-biting imitation of a man thinks he's got me licked. Well, maybe he has, with you. But fire or no fire, factory or no factory, I'll start from nothing and put him out of business. He knows it—and you can sell his wagons if you want to . . . Wally, just to satisfy this mud-slinging blackguard, tell him where we were yesterday morning and what kind of a paper it was you witnessed."

Wally told them, with eyes that blazed as hotly as his boss's and fists clenched at his sides. Then Gil added: "Satisfied are you? Mr. Fosdick, you can make up your mind any way you want to; I'm going back to Detroit and rebuild a plant!" And with that he and his aide strode out of the room.

What a wedding that had been, that ceremony of the day before! To help a lovely, smiling girl into a bright and shining new 1903 model—and hear the news of disaster that had been foretold by the generally smiling face of Wally Burns! To stand before a minister in a long-anticipated ceremony—with the vision of smoking, charred ruins before their eyes! But she pressed close to him—blessed Gail!—her blue eyes looked bravely into his as she responded in a clear voice—"for richer, for poorer—" When the time came for him to say "I do," his voice rang.

"Now—let's go and get a contract," when they had left the church. And—"Good luck, Gil," with a long, warm kiss.

THEN, Jim, after a morning alone with Fosdick, summing up in their final conference with—"he's unlicensed, Mr. Fosdick. And as long as I have anything to do with the A. L. A. M. he'll never get a license. We own the Selden patents; no one can manufacture automobiles legitimately without a license from us." His big voice rumbled triumphantly. "We formed the Association of Licensed Automobile Manufacturers in New York this last week. We have contracted *(Continued on page 161)*



## Every Roof a Landing Field

FLEETS of airplanes taking-off and alighting on the roofs of office buildings and other small spaces may be possible with two inventions of C. Francis Jenkins of Washington, D. C. The take-off device is a launching runway, not unlike the "dips" in amusement parks, while the mechanism which makes possible the landing of airplanes in small areas is a "brake" occasioned by reversing the propeller.

"The inability of the pilot to stop his plane in emergencies," Mr. Jenkins said, "has already been the cause of fatalities both in landing and in delayed take-offs. The automobile has brakes on the wheels and the motor boat reverses its propeller to stop. The airplane, likewise, should reverse its propeller to stop."

"A reversing propeller blade is not new, but heretofore it has been considered too dangerous for airplane use. There was the constant fear that the pilot

might accidentally pull the controlling lever during flight, and this would mean a swift and sure crash."

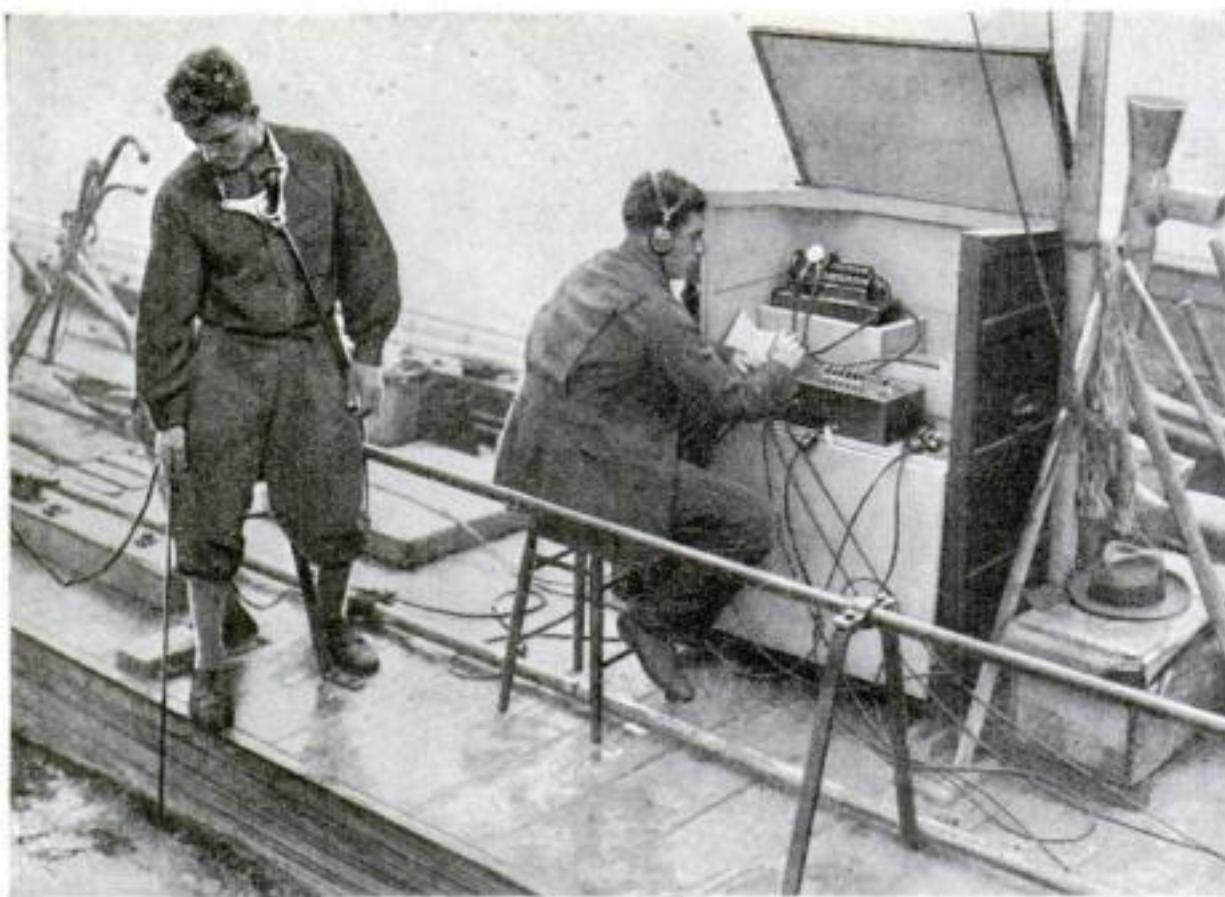
The essence of the Jenkins brake is that the reversing lever is so geared that it cannot be moved while the plane is in the air. When the plane strikes the ground or the roof of a building, a spring automatically releases the safety guard on the reversing control and the aviator is free to bring his plane to rest almost instantaneously. A foot pedal re-sets it.

Jenkins believes his launching and stopping inventions will be a great boon to speedy transmission of airplane shipments.

The Jenkins take-off device is merely a runway of the roller coaster type. Taking advantage of the gravitational acceleration, which is twenty-two miles an hour each second, plus the motor acceleration, the plane can easily attain flying speed by the end of the first second, says the

inventor. With the plane on the launching platform the usual blocks or other acceptable means are employed to hold the aircraft in place while the motor is warmed up.

At a given signal the blocks are released and the plane starts roaring down the runway. It is tilted slightly downward by the elevation of the tail skid runway above the wheel runway; so that at first it has a tendency to fly. As the plane nears the bottom of the launching runway, the tail skid runway gets lower and lower, so that the wings have an increasing lift angle. A safety flange which has hitherto held the wheels against premature flight ends here. The pilot simply holds the control stick at climbing angle from the start; the result is that the plane flies off the runway the moment flying speed is attained, and thereafter continues to climb until the altitude desired is reached.



### Dictaphone in Harbor Records Soundings

TO AID in charting the navigable channels of New York Bay and the Hudson and East Rivers, an office dictaphone has recently been pressed into service. As expert sounders sing out the readings of the depths shown by their "leads," an operator switches them on to the dictaphone and their reports become a permanent wax record, like that of a talking machine, from which maps of amazing accuracy are prepared.

Daily observations by U. S. Army engineers chart every foot of the waters. The work is done from a floating platform, consisting of three barges lashed together and towed by a forty-foot launch.

In the photograph the operator of the dictaphone "stands by" to record the soundings made by the expert, who drops a "lead," or weighted cable, carrying markers to show the length submerged.

### Doctors Vindicate Hair Bob

WOMEN need fear no dire consequences from bobbing their hair. They now have the assurance from physicians of the American Medical Association that slashing their locks "probably has no permanent effect. It probably does not make the hair coarse, or make it grow less vigorously or more vigorously, either for a short time or permanently."

The present masculine fad of going hatless to expose the hair to sunlight, the doctors say, is of doubtful benefit.

### Just a Rainy Day Railroad

ONLY when rain is falling do freight trains puff from Mount Jewett to Smethport, Pa., over a twenty-mile railroad that runs through dense woods. Some time ago it was found that the locomotive sparks caused frequent forest fires; and a notice in the passenger schedule said, "These trains will operate only on rainy days." Later a gasoline locomotive restored passenger service.

Freight trains, however, require steam locomotives to haul their heavy weight; so freight is shipped on rainy days only.



### Fireman Dives in Gas Mask

NOW firemen, proverbially called upon in any kind of emergency, can become divers at will and can go to the rescue of drowning persons. That the standard gas mask used by fire fighters in smoke-filled structures makes a first-class diving helmet was recently demonstrated by Capt. C. H. Virdin of the Los Angeles fire department.

For twenty minutes Capt. Virdin remained under water in a swimming pool, breathing only the oxygen supplied by his mask. He declared the test wholly successful. The oxygen supply was entirely adequate and the respirator waterproof, and the fireman found himself unencumbered by the great weight of ordinary diving equipment. It would have been a simple matter for him to find and seize a drowning swimmer and bring him safely to the surface.

### Fighting a Gorilla in a Tunnel, Man Finds Him Left-Handed

THE gorilla, unlike his supposed relative, man, is naturally left-handed. When the gorilla attacks, he uses his right hand as an auxiliary to his two feet in running, advancing with his left hand outstretched. So we are told by Col. H. F. Fenn, just returned to London with gorilla specimens obtained in the Kivu district of the Belgian Congo, Africa.

In the Kivu bush the gorillas make tunnels four feet high. Colonel Fenn had just entered one of these when a gorilla, with mighty left hand outstretched and mouth open, rushed at him. The beast was only seven feet away when Colonel Fenn fired from the hip and killed him.

### Sleeping Sickness Kills 5,000

IN THE last five years more than 5,000 people in England and Wales have died of so-called sleeping sickness, says the British Minister of Health. About thirty percent of all cases die; the rest result in disorders ranging from mental ailments to complete paralysis. Research to combat the scourge is urged.

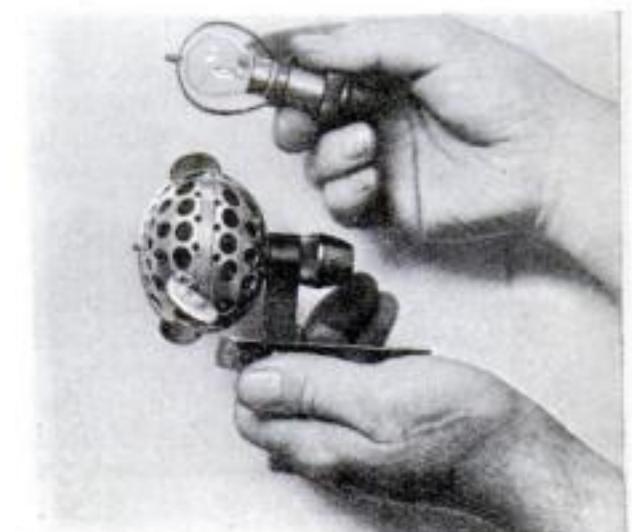
### Seedless Grape Defies Winter

CAPABLE of withstanding the rigors of New York winters, a new variety of greenish-yellow, seedless grape is announced by Dr. A. B. Stout of the New York Botanical Garden. It was bred by this institution, in co-operation with the State Experiment Station, located at Geneva, New York.

### Windmill Rainbow Car Light

GYRATING spots of colored light ornament the front of an automobile to which is attached a new "windmill-flasher." It may designate college colors, or red, white and blue for patriotic occasions; more practically, it may indicate bus routes or distinguish physicians' cars, ambulances, police and fire apparatus and mail trucks for traffic right-of-way. Moreover, it makes a safety or parking light when placed on the left of the car.

Within the device is an ordinary electric bulb, as shown below in the illustration. Around it revolves a metal shell with small circular glass windows of any desired colors. Tiny windmill vanes rotate the shell when the car is moving or when the wind is blowing strong enough.



The air rotates this cover when the motor car carrying it moves, and the light shines through

## Metal Mirrors of Flappers in Ancient Greece Unearthed

YOUNG women of three thousand years ago enjoyed admiring themselves in hand mirrors no less than modern "flappers" do. That is indicated by recent discoveries at Media, in Greece, by the Swedish Archaeological Expedition. Digging into tombs of the Mycenaean period—nearly a thousand years before the days of the ancient Greek philosophers—the archaeologists came upon several hand mirrors, one with an ivory handle.

Since silvered glass was unknown then, the mirrors were made of sheets of polished metal. Even before these were invented, ancient damsels used mirrors of polished stone, dipping them in water so that the thin film of liquid would serve as a reflecting surface.

## "Mechanical Ears" Beat Man's

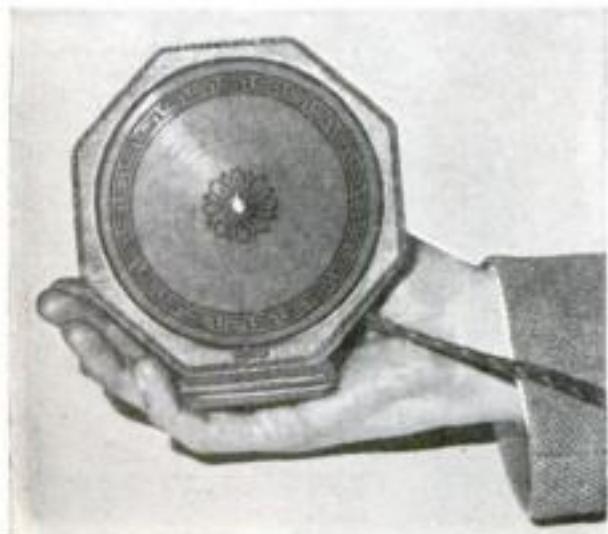
SO DELICATE are the "mechanical ears" perfected by scientists to detect sound waves in the air, that a gun fired on the east coast of England was "heard" at Birmingham University, more than 135 miles away. The sound was not heard by human ears, but was detected by the recording instruments.

## Movies Made More Natural

NATURAL motion picture effects are claimed for a new camera whose movable back, connected to the lens by a flexible bellows, is shifted about by a system of cams and levers while the pictures are being taken. The photographs are said to appear more realistic than ordinary "movies"; they show relative movement between the near and far planes of the picture, such as you see when you move your head sideways, adding to the stereoscopic effect of depth.

## A Not Quite So Loud Speaker

IF YOU live in an apartment, some of your neighbors will appreciate the remarkable midget cone speaker, pictured below, used late at night on your radio set. Although its tone quality is said to be admirable, it gives a subdued radio program that will not annoy would-be sleepers. The all-night radio fan can pursue his hobby unmolested when he uses the new instrument; it is also recommended for a sick room, where its quietness is soothing to the listener's nerves.



A midget radio loudspeaker that fills a room, but yet doesn't disturb sleepers in other rooms



## A Realistic Mechanical Football Contest



### Lawn Mower of Razor Blades

WHEN F. M. Durkee, of Brookline, Mass., found that an illness had unfitted him temporarily for pushing a lawn mower, he built a unique electric mower. A vacuum cleaner furnished the handle, and the wheels came from a toy cart. Brass disks edged with razor blades for cutters were driven by bicycle hub sprockets under the power of a small electric motor.

So successful was the machine that he has recently perfected an electric lawn-mower that incorporates its features—shown at the left of the original. It is said to cut grass quickly and uniformly at less than the cost of running an electric flatiron. The long cord plugs directly into the nearest socket of house or garage. Five four-bladed cutters make a swath seventeen inches wide.

THIS clever game, operated with hand levers, simulates a contest between two football teams in a large, glass-inlosed cabinet. Two persons play the game, each controlling the actions of his team. When one man presses his lever, all the players on his side kick, while the guards protecting the goals shift defensively. The shape of the field causes the ball always to come to rest at the movable or kicking foot of some player so that action is assured.

Each miniature player is clothed in a wool sweater. The field is painted grass green, while a lithograph in the background pictures a grandstand filled with rooters. The game is designed for clubs and amusement parks.

## Nation's Gas from One Plant

CONSTRUCTION will soon begin, it is reported, on a vast project to supply nearly the whole of Germany with gas for all household and factory use from a single great generating station located in the coal fields near the steel-making center of Essen. As in America, German cities at present are supplied by local gas plants to which coal or coke is hauled by rail. For the new scheme it is contended that transportation of gas through long pipes is cheaper than rail transportation of the original fuel.

Germany will be covered with a vast network of pipe lines radiating from the central generator at Essen.

## Electric Baths for Noses

A NEW way of treating colds by applying electric heat to the inflamed interior of the nose was recently advocated by Dr. H. Bordier, of Lyons, France.

Metal plates are applied at each side of the nose and the electric current is sent between them so that the inner membranes of the nose, not the skin, receive most of the heat that is produced. Dr. Bordier reports numerous remarkable successes from a few minutes of such treatment.

## Man Evolved from Dust, Not Apes, Chemist Hints

PERHAPS man evolved, not from monkeys—but from rocks or literal “dust”! That the “spark of life,” long thought to distinguish living creatures from inanimate objects, may be only a myth is the suggestion of Dr. J. C. Drummond, University of London.

Life processes and the chemical reaction of nonliving matter, he recently told the American Chemical Society, are strikingly alike; many experts are commencing to believe that other hypotheses are wrong and that there is no real gap between the two. This adds new interest to the “missing link” between the animate and inanimate worlds, an invisible plant-infecting virus far simpler and lower than bacteria, whose unconfirmed discovery Dr. B. M. Duggar of the U. S. Department of Agriculture announced not long ago.

Air, or oxygen, is not necessary for all life, another expert, Dr. W. Mansfield Clark of the U. S. Public Health Service, told the society of chemists. Though a human being can exist only three minutes in the absence of oxygen, some bacteria can thrive without it.



## “Gasoline” Made from Coal

CHEAP motor fuel from coal, a possibility only recently recognized here and abroad, is said to be produced by a new British invention. In this process, discovered largely through the researches of a London woman, coal is distilled to produce a crude oil that can be refined into a gasoline substitute. The illustration above shows the experimental apparatus which is used for refining the crude oil that is the first product of the new process. In commercial use the manufacturing outfit would be two hundred times larger. Powdered coal would be an important by-product; its sale for use in generating electricity would help lower the cost of making coal gasoline.

## Seasickness Laid to Plain Fear

FROM the Battle Creek Sanitarium in Michigan comes the statement of Dr. W. N. Boldyreff, physiologist, that fear, more than the pitching of a vessel, causes seasickness. Fear disturbs the digestive juices, with resulting turmoil. The power of suggestion in overcoming fright, he declares, is a better remedy than all the drugs you can carry.



## A Mail Box for Motorists

HAVE you ever stopped your car at a street corner and wished there were some way of mailing a letter without getting out? “For Motorists Only” is a new mail box that is being tried at Oakland, Calif., in response to a suggestion from postal headquarters at Washington. Users of the novel mailing device can draw up alongside it in their cars, open the slot by a convenient handle, and deposit their letters without leaving the machine. The new scheme eliminates parking congestion near the post office.

## Surgical Chisel Driven by Air

CUTTING a human being's bones is the latest use discovered for a small compressed air hammer and chisel formerly used for delicate riveting and engraving on stone. Each of its 3800 blows a minute is only a light tap; their combined effectiveness, however, gives the surgeon a valuable tool for rapid cutting during an operation. Dr. Horace C. Pitkin, at the Massachusetts General Hospital, adapted the device. He solved the difficulty of getting pure compressed air by passing the supply through an alcohol filter.

## Second Highest Dam Planned

PLANS are under way to dam the Owyhee River, in Oregon, with a 360-foot wall across the canyon. With the exception of the Pacoima Dam near Los Angeles, now building, this will be the highest in the world. At present the 351-foot Arrowrock Dam in Idaho holds the mark.

## Microbes Produce Copper

EVEN microbes can aid in the production of copper. Not long ago the Geological Survey was mystified by the discovery of small spongy masses of pure copper in a bog near Cooke, Montana. Considerable copper ore exists near by; investigation revealed that some of this ore, dissolved to reappear in the bog, had been precipitated as pure metal by the tiny organisms. The quantities were too small to be of commercial value.

## Full Novels on Phonograph Produced by New Process

NOW a phonograph can “read aloud” to you—a full length novel, if you wish. Or it can give you an entire Congressional debate. An English radio concern announces that Capt. Round, one of its engineers, has developed a process to record a whole novel on six double-faced, twelve-inch phonograph records. Each record “reads” to you for forty minutes, at normal speed. They are of greatest benefit to blind persons. Like these new English records are those invented not long ago by Thomas Alva Edison, and described at the time in POPULAR SCIENCE MONTHLY. They, too, play for forty minutes.

## Solid Tires May Blow Out

BLOWOUTS can occur even in solid tires, for heat generated by speed may melt the rubber, forming a gas within that would explode.

## Ship Made with Two Tools

A POCKETKNIFE and a piece of glass sufficed Mowritz Peterson, of Portland, Ore., to carve an all-wood model of the frigate *Constitution*. Even the thirty-seven sails are of wood, shaved down to a thickness of an eighth of an inch. The task took a year.

## Wire Stretcher Saves Fence

SAGGING fence wires are quickly made taut with the aid of a new wire stretching tool. Its powerful jaws grip and pull together the offending line; a chain holds the tool set while a splice is made. Any sort of wire, plain, barbed, or woven, is easily handled; without teeth, the bulldog jaws cannot injure it. Thus old wires can be kept tight, prolonging their use for years. The wire stretcher is easily carried to the place where the slack is, and there used to take it up.



Toothless and harmless, yet tenacious jaws of this stretcher draw sagging fence wires together for repair. The chain holds the position

## Time Clock Held on Sound; Speed, 1,100 Feet a Second

FOR the first time, physicists have succeeded in measuring accurately the speed of sound waves in liquids and, incidentally, have discovered surprising new facts about sounds that are far beyond the range of human ears. By an electrical apparatus called a "sonic interferometer," Dr. John C. Hubbard and Alfred L. Loomis, in the latter's laboratory at Tuxedo Park, N. Y., have measured the action of waves which vibrate from 200,000 to 400,000 times a second and are from one eighth to five sixteenths of an inch long in liquid. Our ears cannot hear sounds which vibrate faster than about 20,000 a second. The vibrations of middle C on the piano are only 256 times a second, and the resulting sound waves are about four feet long.

Sound travels through pure water at a temperature of sixty degrees F. at 4,850 feet a second. If the water contains one half of one percent of salt the speed increases to 5,050 feet a second. A similar increase results when the temperature of the water is raised to seventy-seven degrees. The speed of sound in the air is about 1,100 feet a second.

## Ocean Undercurrents Filmed

OCEAN currents far below the waves are studied with a new device described by P. Idrac before the French Academy of Sciences. Their direction and speed are automatically charted upon a photographic film fixed to a revolving drum.

## "Foot Fins" Help Swimmer

FUTURE aspirants for Channel-swimming honors may benefit by these novel "foot fins," said to make progress through the water easier and faster. They are fastened to the shoes as shown in the illustration. When the swimmer draws up his legs in the first movement of the swimming stroke, the odd fins close and offer little resistance in passing through the water; but as he kicks to propel himself they open and double the effectiveness of the stroke.



Faster swimming is claimed for "foot fins." Closed when legs are drawn up, they spread and add power when they are thrust back



## Rest for Overworked Tongue

THERE'S no need to lick envelopes when you have this handy new tool that does the job for you. It contains a reservoir of water, filled by removal of a rubber plug. Through an easily regulated valve, exactly the right amount of moisture is said to reach a grooved metal roller that applies it to the envelopes. Since the working parts are of metal, they are not easily clogged or "gummed up" as are felt or fabric moisteners.



## Dangling Straps Warn Motorists of Trains

HANGING leather straps form a novel railroad crossing warning to motorists where they have recently been installed at Vermilion, O., recalling the rope signals that tell railroad men that they are approaching a low bridge. A thousand feet each side of the point where the tracks cross the motor road, the new markers dangle to flick each passing car and call its driver's attention to the need for reduced speed. The flexible straps offer no real obstruction. The ingenious device is said to be marvelously effective; few disregard its message of caution, which is effective both by day and by night. Additional advantages are that the warning is inexpensive to construct and costs virtually nothing for maintenance and absolutely nothing for its operation.

## Hope Dashed for Gold in Sea

NOW the possibility of extracting gold from sea water has been investigated by Dr. Fritz Haber, German chemist of world reputation. Even more remote than hitherto believed is the chance of doing it on a successful commercial scale, he concludes. Five thousand analyses of sea water show that while it contains gold—from one to a thousand ten-

## The Flameless Fire of Rust Causes Losses of Billions

NEW metal alloys, protective coatings of special metals, and base metals of extraordinary purity are chemists' latest weapons in the battle against rust.

Electroplated coatings of cadmium or zinc—or, where fine appearance is demanded, nickel or chromium—will protect metal cables and household silverware alike, according to R. M. Burns of the American Bell Telephone Laboratories. Aluminum has been successfully tested by the U. S. Bureau of Standards to coat the duralumin alloy framework of airplanes. It is sprayed on by a new process.

If skyscrapers had gold skeletons and we ran gold locomotives on golden rails, we would have no rust problem—for that metal does not rust. Meanwhile, we spend more money for paint to keep things from rusting than is contributed to all institutions of scientific research and of higher learning combined. Billions of tons of steel in buildings and machines are consumed by the flameless fire of rust.

## A Correction

IN OUR October number, in the report of the conversation between Commander Byrd and Mr. Roy Guffin, it was stated that an enlisted man in the Army, Navy or Marine Corps is not permitted to pilot an airplane. This was an error, for, as a matter of fact, in all three branches of the Government service enlisted men who show aptitude for the work are trained as pilots and permitted to fly.—THE EDITOR.

## 2,000,000 Lepers in the World

THE world has 2,000,000 lepers today, according to William J. Eddy, secretary in Australia for the Mission to Lepers. One-fourth of them are in China. India has nearly as many.

# Man's Creative Genius



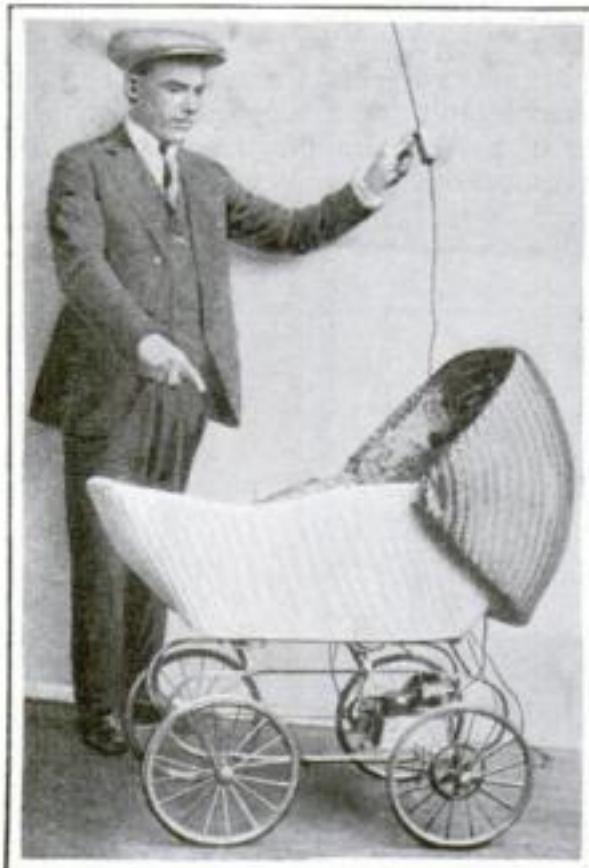
**A Home Hair Clipper**

Any light socket operates this little machine that saves visits to the barber



**Gun Shoots Light Rays**

Brigadier General J. W. Lamont, retired, of Great Britain, has invented for safe target practice a "flash spotter," a rifle that shoots, instead of bullets, a ray of electric light hitting the object just where the bullets would, since it is directed by the gun barrel. It is shown above being tested at the Toronto, Canada, barracks

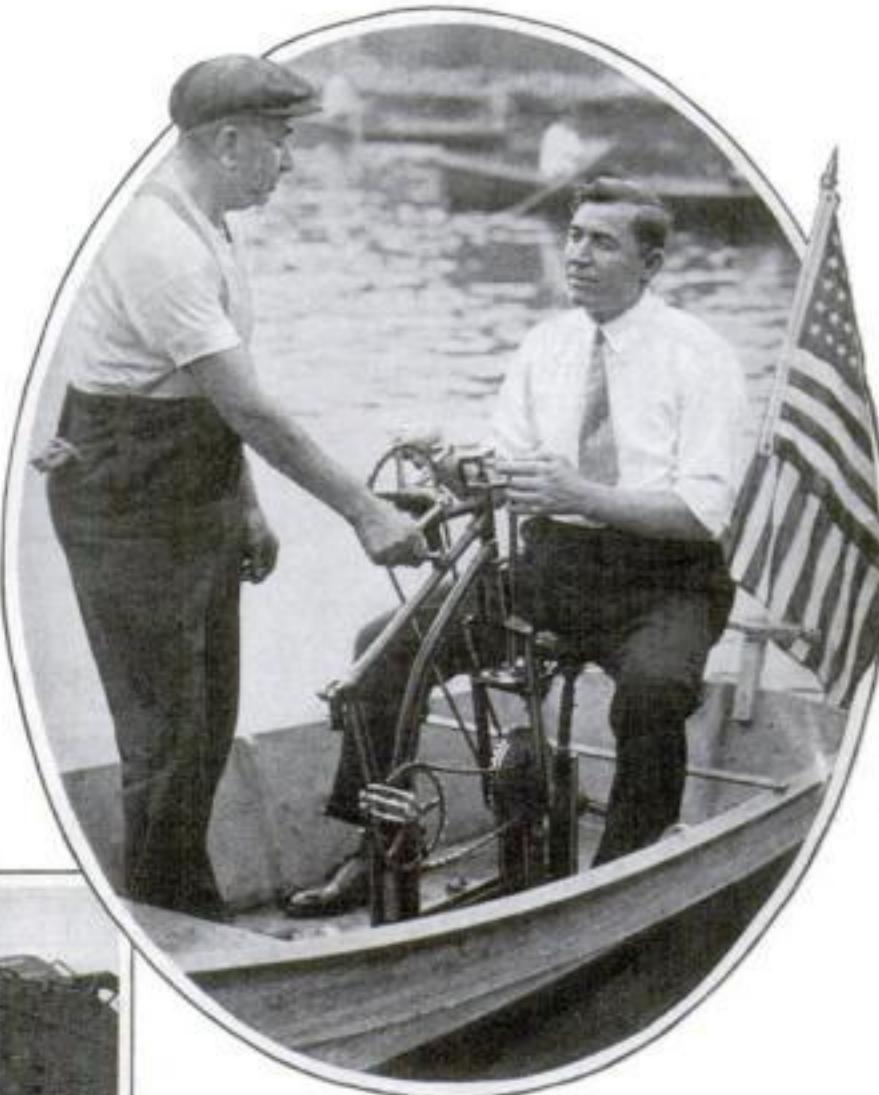


**Babies Rocked by Electricity**

A Chicago man invented this device for tired mothers. When the switch is turned a small electric motor, attached to the rear axle of the carriage, gently moves the springs

**New Golfing Machine**

For golfers who just can't learn to keep the correct posture, or stance, a simple device has been provided that will force them to take the proper attitude until it becomes a habit. R. C. Crocker, of Toledo, O., conceived the idea of a rigid iron hoop, supported by three pronged legs, inside of which the ambitious player stands. An advantage, and highly important, is that the hoop can be made larger



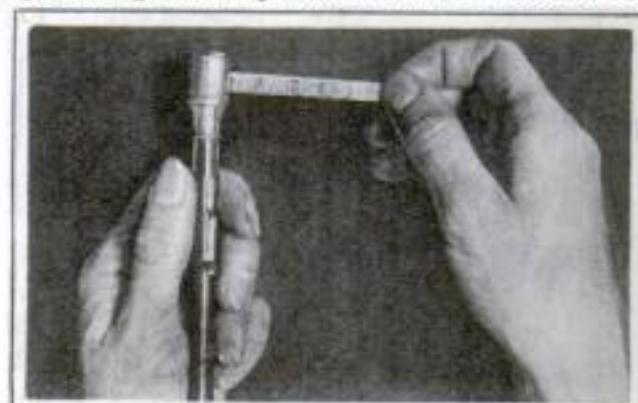
**New Bicycle Boat**

Bicycle pedals and an extra sprocket turned with the hands operate the propeller of the boat in which Fred Kurth, its inventor, is shown in Central Park, New York City. A tiny steering wheel operates the unusual craft's rudder



**Blast Precools Fruit Cars**

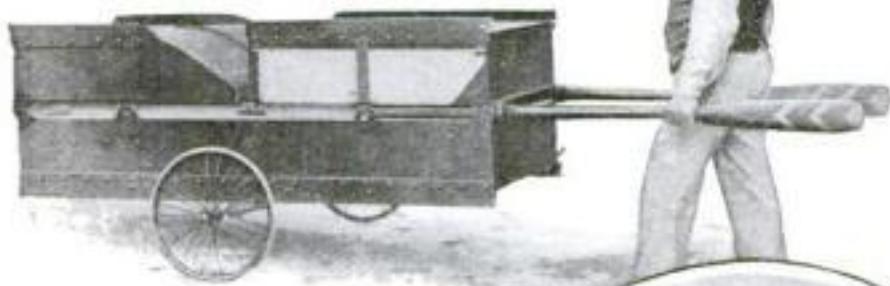
When a car is filled with fruit in the Imperial Valley of California, a new precooling service reduces the temperature of car and contents from 100 or more degrees to 40 in a few hours. The old way of simple icing takes days. Iced air is forced into the car, circulated and drawn out for rechilling, all by a blower installed in a motor truck



**Tape in Pencil**

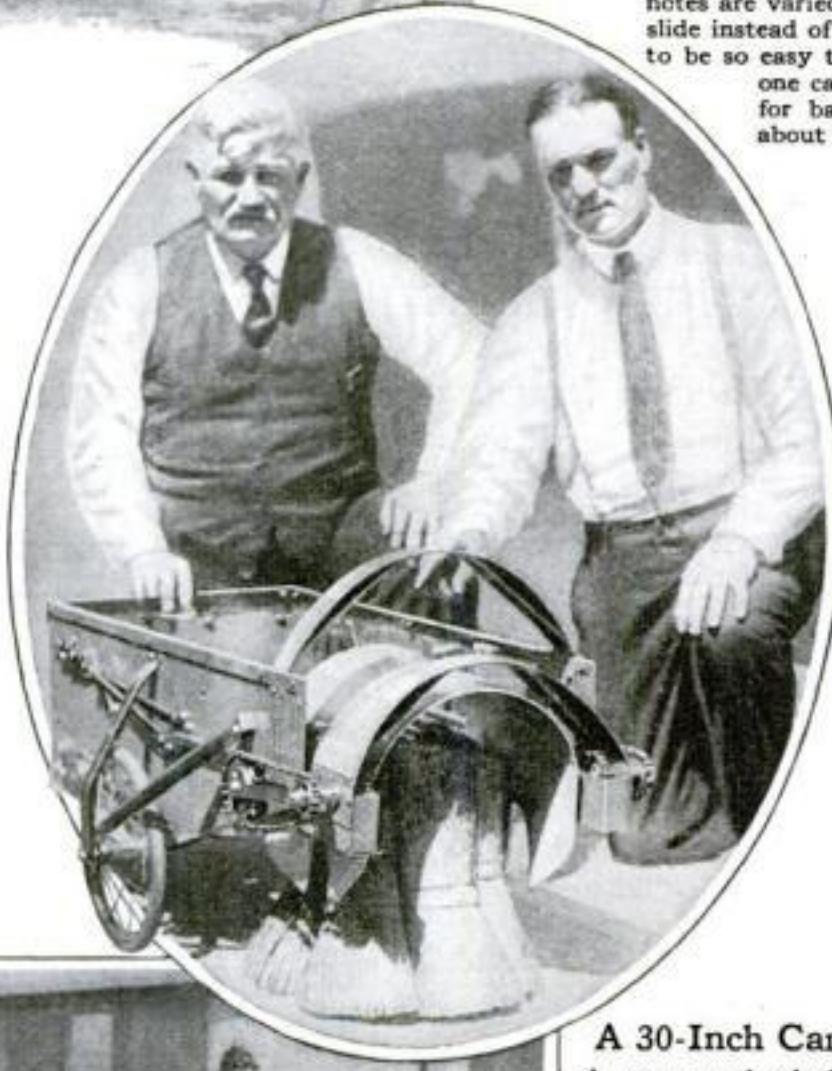
A new magazine pencil has six extra leads in the barrel, and a handy spring tape measure in the top serves to increase its utility. The measure can be locked at any length to prevent its rewinding

# Meets New Problems



## A Folding Boat

Two end sections of a French camper-inventor's boat fold down. Standing on end it is a bookcase or wardrobe trunk. Lying flat, it is a fair bed. For portage, wheels are attached, oars serving as handles. Afloat, it can mount a sail. About all you can't do with the craft is put it in your vest pocket.



## Shocking by Foot

A machine, worked with a pedal, which shocks grain, binds it and drops it in neat rows, according to its inventors, is exhibited by them at the right. They are F. W. Schultz, a farmer, and J. G. Holifer, a mechanic, both of Portland, Oregon.



## A 30-Inch Car

A motor car that looks as if it had been turned on its side and then stepped on is used in the Olive View Sanitarium, California, for all sorts of service in which it is necessary to traverse narrow walks and corridors. It was "squeezed" by shortening the drive shaft and cutting off sections of the axles so that the auto now is only two and a half feet wide. The chassis itself is also shortened.

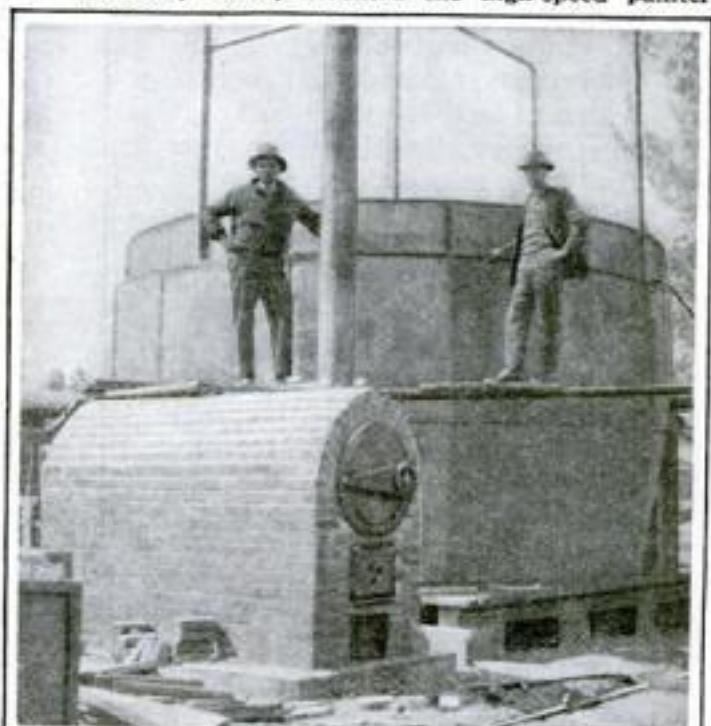


## Keyless Saxophone

An English saxophone whose notes are varied by an easy slide instead of keys is said to be so easy to learn that one can fit himself for band work in about half an hour.



**Motor Paints Road** Twenty miles an hour is the rate at which a new machine, mounted on a motorcycle side car chassis, paints road marks. Two metal disks gage the mark and keep it even. J. G. Collins and J. Arseneaux, of Houston, Texas, invented the high-speed painter.

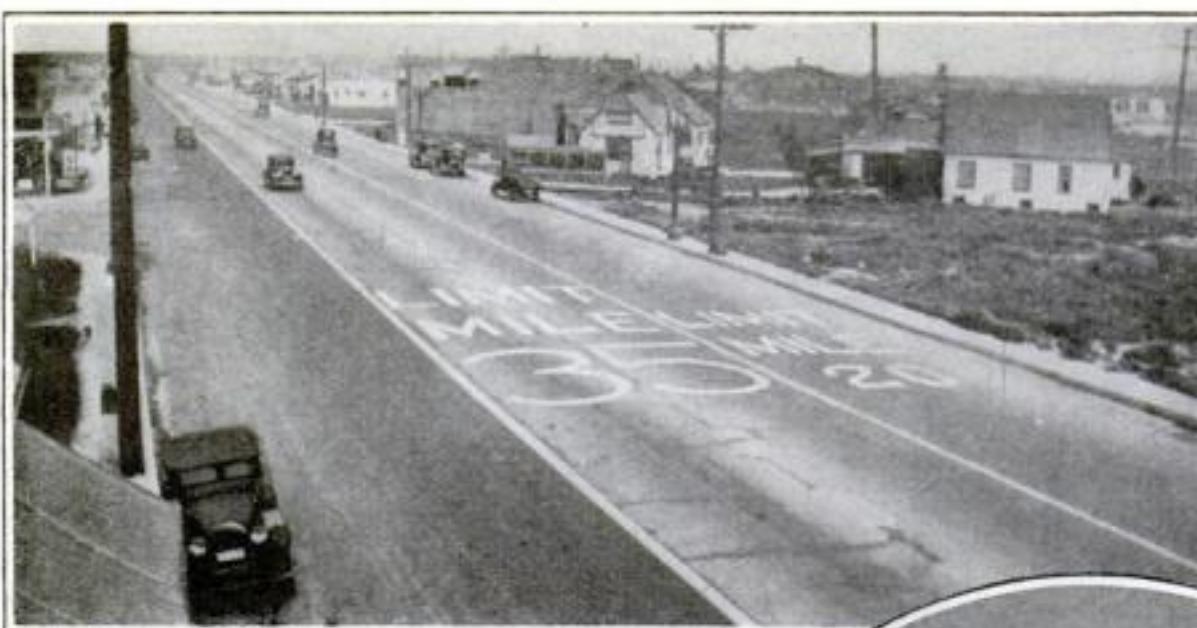


**Gas Is Made from Sawdust** A fifty-cent load of sawdust and \$2.50 worth of fuel make gas in the plant shown here for a month's cooking and heating in a Yakima, Wash., automobile camp of twenty houses. Sawdust and rubbish, baked in the brick oven for an hour, produces the gas.



## Side-Vision Glasses

A spectacle frame whose fashionable large bows do not obscure vision to right or left has just been invented by Dr. Ernest E. Emons, of Akron, O. These bows are attached to the tops instead of middles of the lens rims, giving added advantage of eye-glasses.



### Express Lanes for Motoring

A SMALL community between Los Angeles and Long Beach, Calif., recently conducted an experiment to speed up through automobile traffic.

A mile of highway was widened to sixty feet and divided into three traffic lanes. In letters seven feet high and numerals fourteen feet high speed regulations were painted on the road.

The middle lane, for express in both directions, required speed of thirty-five miles an hour or more. In one-direction side lanes, for local traffic and parking, the speed limit was twenty miles an hour.

Although the plan proved popular, the State Motor Vehicle Department stopped it because of a technical conflict with the state law; but it may eventually be generally legalized and adopted.

### KNOW YOUR CAR

IT IS easy enough to learn how to handle a car on dry roads. Any competent instructor can teach you. But handling a car when the roads are wet and slippery brings you face to face with a whole new set of problems. The worst of these is that of skidding.

The proper way to pull the car out of a bad skid depends on the type of skid and your success is determined by the quickness and accuracy with which you apply the remedy.

Experienced drivers dread a front-wheel skid most, because when it starts there is almost nothing you can do except hope for the best. A front-wheel skid usually comes when you turn the wheels suddenly at a sharp corner and the car instead of turning goes straight ahead. Avoid this by taking the corners slowly.

If the back wheels skid, take your foot off the brake and steer in the direction toward which the back wheels are sliding. You can usually stop the skid if you act quickly. Remember that medium-soft tires are not so likely to skid as tires pumped to maximum pressure.



From the paper strip the totalizator cuts off a ticket for the race better in Australia. Then it figures his return if his horse comes in first

### Home Heated by Sawdust

COAL bills may be saved by a device which makes practicable the use of sawdust as fuel, according to the producer, a Portland, Ore., hardware concern.

The sawdust is poured into the tall metal can, the outlet of which is against the opening into the fire box, as shown at the right. The natural draft into the fire box draws the fuel into the furnace. A lever controls the outlet of the sawdust container, making it larger or smaller and so varying the supply.

### Crusoe's Isle an Eden

ROBINSON CRUSOE was more to be envied than pitied, according to Dr. Waldo L. Schmitt, of the Smithsonian Institution, Washington, D. C. In a recent survey of Juan Fernandez Island, on which Alexander Selkirk, the reputed original of Robinson, lived over four years, he found the island one of the most fruitful spots in South America, and said:

"Every imaginable plant seems to grow there. One Frenchman was shipwrecked on the island forty years ago. He likes it so much he refuses to leave."

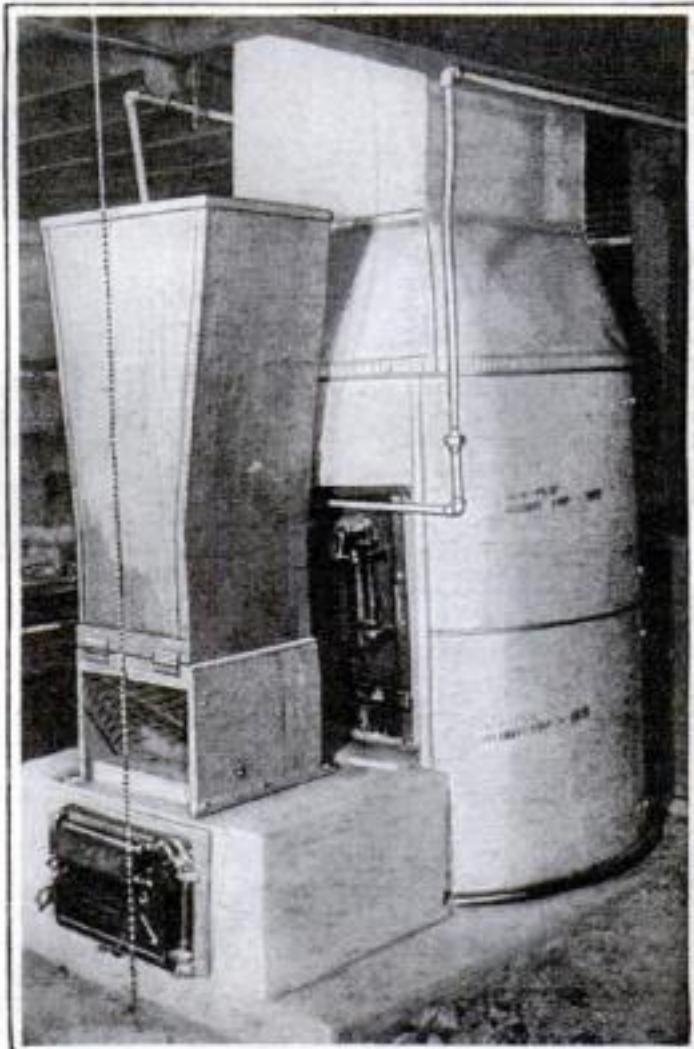
### Horse-Racing Odds Figured by Mechanical Bookmaker

TOTALIZATORS that record all bets, determine the odds and apportion the winnings have been put in use at the Australian and New Zealand tracks, where horse racing and speculating on the results is legal, as it is in some states in America. The totalizators, one of which is demonstrated in the photograph below, are mechanical calculating machines, whose service is somewhat like that of the pari-mutuel machines in use in Canada, Kentucky, Maryland and elsewhere. The machine records the money each better has risked and the horse of his choice, issuing a ticket to bind the bargain. Then it computes the odds, according to the bets, determining how much is due the winners.

### Some Power!

EIGHTY billion kilowatt hours of electricity will be the total used in the United States during 1927, according to Department of the Interior estimates based on the present output and on figures for last year. This tremendous total of electric energy, properly applied, would be sufficient to hoist a fair-sized mountain (one cubic mile of granite or basalt) a mile into the air!

Due to longer daylight hours and warmer weather electricity consumption drops three percent or more in summer.



Sawdust poured into this can in front of a furnace is drawn by the draft through an opening in the bottom of the can into the fire box and is burned instead of coal, thus cutting fuel bills

## If the Sun Should Blow Up We'd Live Only 138 Hours

SHOULD the sun blow up, some day, you would have exactly 138 hours to live. By the end of that time the burning gases would reach the earth and all life would be annihilated, according to C. T. Elvey of the Northwestern University.

A study of the stars, at the Yerkes Observatory, led him to this conclusion. Stars do explode, he points out; the last such celestial catastrophe occurred when Nova Aquilae was seen to blow up in a flash of light last August. There is no reason, he says, why the sun should not do the same at some future date.

## Tenting on an Iceberg

AS WINTER'S chill draws nearer, would you swap your comfortable home for a dwelling on an iceberg? That is what John B. Simpson, British scientist, has just done. With a dog and a phonograph for company, he recently left England with the intention of making his home for three months on an ice floe.

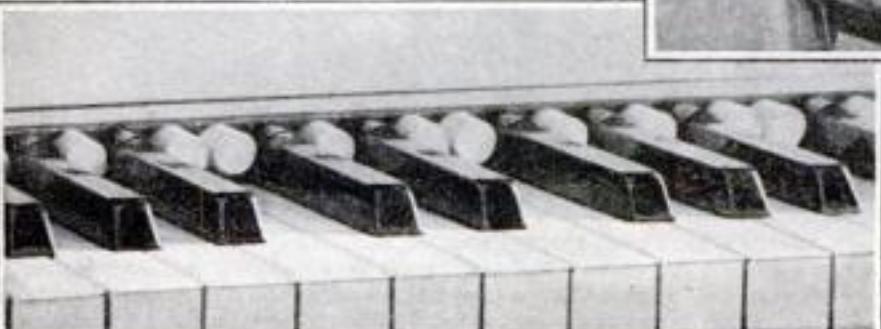
"My purpose," Simpson said, "is to gather material for a book on the ice fields. I expect to be very comfortable on some drifting iceberg. I shall erect a fur-lined tent, and warm it with an oil stove. I have plenty of reading matter and a phonograph."

Where his frigid domain will drift to, Simpson has no idea; however, he says he has a collapsible rubber boat which would keep him afloat in an emergency.

## New Gliding Effect on Piano

MUSICAL effects hitherto impossible with the piano are obtained by a remarkable new keyboard recently demonstrated to musicians at San Francisco. With this innovation, you can run your finger up or down the scale striking in rapid succession every black and white note on the keyboard—producing what musicians call a chromatic glissando, or full-scale glide.

Since the black keys are elevated above the white on a standard keyboard, only the most extraordinary performers can run over both sets of keys at high speed. In the new arrangement, regarded by experts as an important improvement, each key, black and white alike, carries at its back a small roller, all rollers being on one plane. When the player wishes to obtain the effect of all the notes in quick succession, he simply slides his finger over these rollers. New and pleasing combinations of sound are obtained with the device.

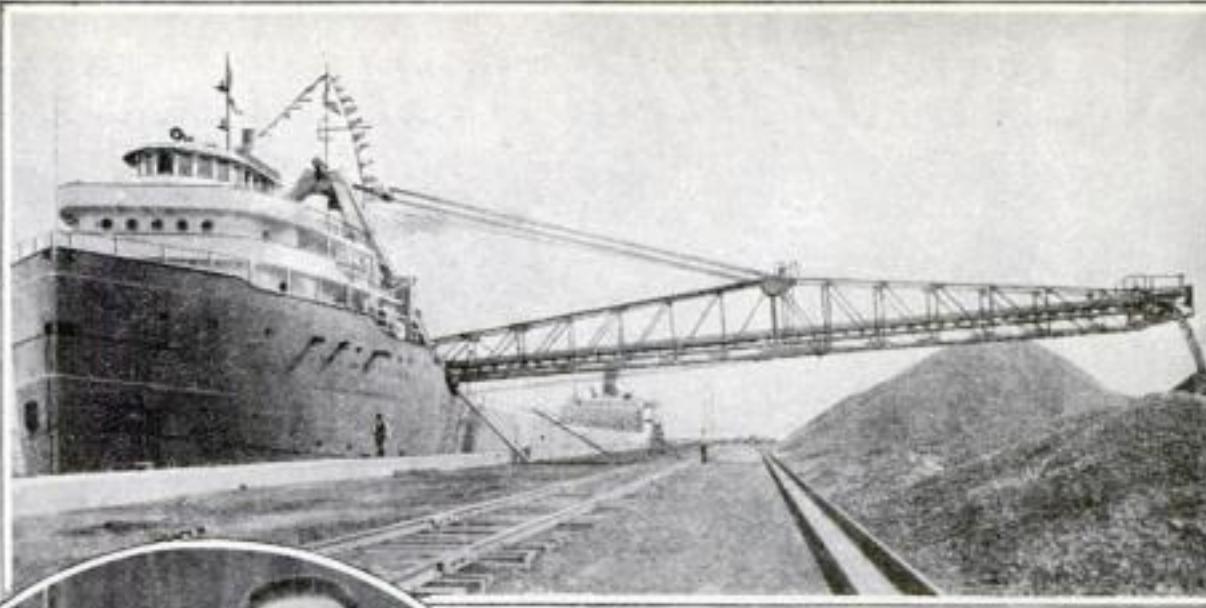


For playing a chromatic glissando—a run of all notes of black and white keys with maximum celerity—this piano has rollers attached to all keys at the back on one plane. Run your finger over these as the player shown above is doing and the trick is done



## Priest Makes Safety Devices

INVENTING new railroad safety devices is the spare-time occupation of the Rev. Father Joseph Szuchy, Catholic priest of Perth Amboy, N. J., who is shown in the photograph in his shop with one of his productions. His latest invention has just been purchased by a New Jersey railroad; dozens of others have come from his workshop, where he has perfected them with the good of mankind and not money gain his chief incentive. Father Szuchy commenced his work of practical benevolence seventeen years ago, when he read of a tragic wreck at Bridgeport, Conn., caused by faulty safety devices, and realized the need of improvements.



## The Mechanical Stevedore

LARGEST boat ever to ply the Great Lakes, the 683-foot *Carl D. Bradley* recently unloaded at Buffington Harbor, Ind., what is said to be the biggest cargo ever carried by a vessel of her class. With her own automatic electrical machinery, the million-dollar vessel discharged a 15,000-ton load of limestone at the rate of a ton a second!

When the vessel's tremendous crane has been swung into the required position its endless series of automatic carriers pours a constant stream of rock onto the storage ground. This machine adds more than a little to the cost of the craft. It soon pays for itself. It saves the cost of labor of hundreds of men who would otherwise be required to shovel and cart away the cargo.

## How Much Do You Know of the World You Live In?

TEST your knowledge with these new questions, chosen from hundreds readers have sent in. Correct answers are on page 145.

1. How do we know that great lakes once existed in the North American deserts?
2. What is the largest lake in the world?
3. Where is there underground ice all summer?
4. Where do fishermen persuade fish to jump into boats?
5. What city is famous for guava jelly?
6. What is the lightest wood in the world?
7. What European country is partly below sea level?
8. What is a baobab tree?
9. What is the oldest city in the world?
10. Where are many ancient cities now buried by desert sand?
11. Where was the most violent volcanic eruption?
12. What is the driest spot in the United States?

# New Phases in Aero Progress



Receipt of a shipment of typewriters by air is shown at the left

The first "air truck" carrying typewriters was tried successfully recently at Curtiss Field, New York, when the Royal Typewriter Company had two cases of three machines each dropped with parachutes from a Ford all-metal monoplane. The photograph at the right shows a case being released from the aircraft high in air. The box landed gently and the machines were found to be in perfect condition, although they had virtually the usual packing.



THE wave of popular enthusiasm for aviation, only recently awakened, has engulfed the makers of airplanes. Cincinnati factories report twice as many orders for planes as they have any chance of filling in the near future, and in many other localities the situation is the same. A single order for fifty airplanes reached a Kansas City concern from a New York distributor, who expects to sell them immediately.

One Lansing, Mich., manufacturer has enough orders to keep his plant working at capacity for six months. Detroit factories are rushed, and a Troy, O., concern, which will turn out 600 small airplanes this year, says it could sell 5000 if it could make them. Many are purchased by individuals or groups for pleasure, instruction, mapping and aerial photography.

## Students in Flying Record

DURING last summer, 262 ensigns of the Annapolis graduating class of 1927 flew a total of 30,302 miles in perfect safety, according to reports just made public by the Navy Department. The flights were unmarred by forced landings or accidents of any sort. Each student obtained about seven and one third hours' flying, and training in aerial gunnery, navigation and radio.

## New Air Endurance Mark Set

IN A Junkers all-metal monoplane, two German pilots, Johann Risticz and Cornelius Edzard, recently established a world's record for endurance flight. Staying in the air for fifty-two hours and eleven minutes, the two airmen beat the mark of fifty-one hours set not long ago by Clarence D. Chamberlin and Bert

Acosta in a test of the Bellanca plane that later carried Chamberlin from New York to Germany. The German airmen hope to fly their monoplane across the Atlantic in the reverse direction; storms defeated their first attempt.

## Air Explosion Peril Reduced

ELECTRIC wires that can't cause dangerous sparks if they break will reduce the hazard of explosions on Britain's new super-airship, which will carry one hundred passengers and a crew of fifty men.

For electric lights, newly invented

wires of insulated aluminum are inclosed in a metal sheath which if the inner wire, which carries the current, breaks, will confine the sparks.

Explosive hydrogen gas, used abroad to inflate gas bags, makes the extraordinary precautions necessary. In the United States, noninflammable helium gas is used.

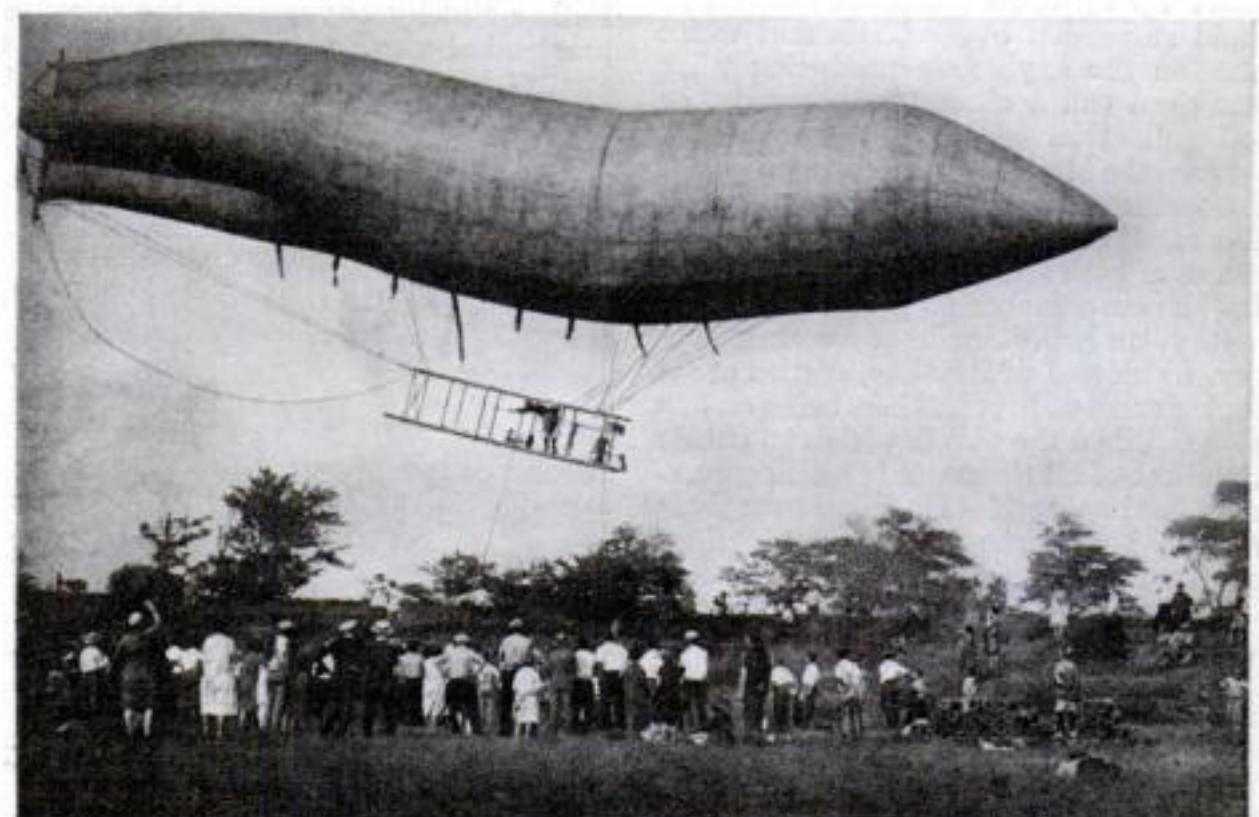
## Red Lights to Warn Flyers

JUST as red lanterns warn motorists of dangerous obstructions, danger signals will be used to mark radio towers, flagpoles and other menaces that might bring an airman to grief. The Army Air Corps, the Bureau of Aeronautics, and the Department of Commerce have just approved a standard safety program, in which all high towers will carry flashing red lights by night. They must be painted red for daylight observance.

High electric wires will be marked during the day by streamers or cones hung from adjoining wires; at night, by fixed white lights.

## Flyer Safe in Four-Mile Fall

WHEN his parachute failed to open, Jean Van Leare recently fell headlong nearly four miles in France. Only three hundred feet from the ground, by some unexplained miracle, the parachute snapped open and landed Van Leare gently in a tree. Foresters found him and revived him. "I am astonished to find myself alive," the aviator said. He was unhurt, and able to tell how he had lost control of his plane and had been forced to jump. Instead of being dashed to pieces on the ground, as he expected, he suffered only a slight rush of blood to his head from the dizzy plunge.



Here is the "hop-off" of the homemade blimp in which Anthony A. Hensler waged a fight against death recently before he finally landed it on a marsh near Flushing, L. I. The craft, built by M. F. Hamza of Union City, N. J., has a 19-foot frame, covered with specially treated linen, containing 15,000 cubic feet of explosive hydrogen gas, propelled by a nine-horsepower motor. Leaving Union City, Hensler made New York, despite high wind, but over Flushing Bay he discovered gas leaking through a foot-long hole. He steered for land and reached it for a bumpy landing.

# Mid-Ocean Plane Stations—Aviator Delivers Packages by Parachute—Flyers in Radio Chat

**N**EW methods of launching planes from warships, say American naval experts, place us five years ahead of any other nation in the matter of equipping fighting ships with aircraft.

Four foreign nations, according to recent reports, have formally offered to exchange some of their own secrets of warship design for the jealously guarded plans of the U. S. Navy's new revolving catapult, a plane-launching device. Their offers have been declined.

## Air Express Cuts Mail Rates

**M**UCH lower than air mail rates for packages are the scheduled charges for the new air express service inaugurated by an express company. Between New York and San Francisco, the rate is \$2.60 a pound, with a maximum package weight of 200 pounds. For shorter distances the charge is less.

Among the cities linked by the air express are Boston, New York, Cleveland, Chicago, Dallas, Salt Lake City, San Francisco and Los Angeles. Explosives, livestock, acids, fragile and extremely valuable articles are refused.

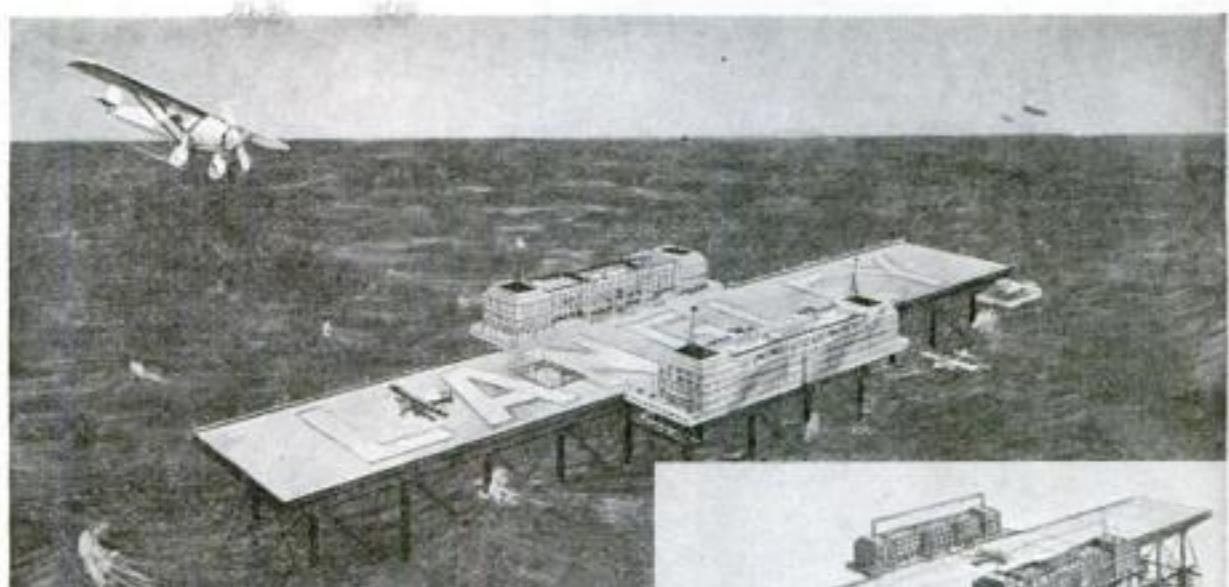
## Two Planes Talk by Radio in Flight

**R**ADIO conversation between two airplanes has been successfully accomplished in Army Air Corps tests at Chicago, the War Department announces. Other achievements included radio orders from the ground to flying aircraft, promptly acknowledged and executed, and a telephone call via radio from a plane to a guest in a Chicago hotel. The tests showed the possibilities of linking radio telephone messages from planes with the land wire telephone systems.

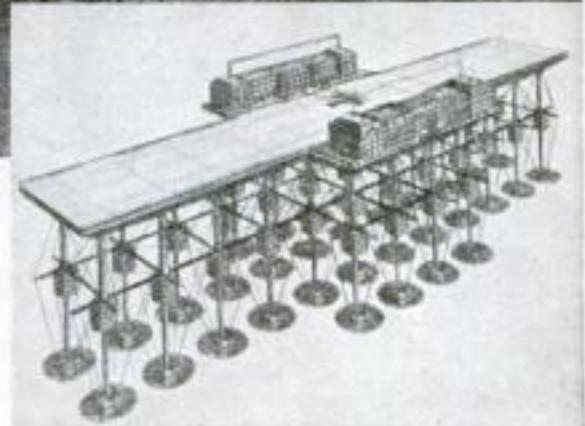
## Volume of Air Mail Leaps

**G**REAT success has attended operation of twelve contract air mail routes that span this country, according to figures just made public by Postmaster General New. Together, they have recently carried more than 50,000 pounds of mail a month. During the last month recorded, ten routes carried more than 1000 pounds apiece as compared with only 1283 pounds handled in one month by all seven air mail routes operating from Le Bourget Field, near Paris.

By next January, the Department of Commerce announces, the air mail will have been extended to serve 184 cities and a total population of 24,000,000. As an aid to aviators, black-and-white and colored "strip maps" of mail airways are now being prepared.



The latest form of the seadrome, or ocean station for planes, invented by E. R. Armstrong of Wilmington, Del., and previously described in *POPULAR SCIENCE MONTHLY*, is illustrated in this drawing and by the model at the right. The long, wide floor would provide space for landing and taking-off as well as building sites



A balloon was converted into a dirigible recently in Italy by substituting for the basket an undercarriage with motor and propeller. The upper photograph shows the converted aircraft in operation, while below is seen a close-up of the carriage, made just before it was attached, giving an excellent view of the mechanism for the propulsion of the queer craft

## Airplane of 2,000 Years Ago

**A**MERICA'S foremost airplane collection—and, in fact, the only one of its kind in this country—is that developed by the Smithsonian Institution at the National Museum, recently described in detail by Paul E. Garber of the museum. Exhibits of man's first attempts to fly, such as the imitation bird of Archytas made more than two thousand years ago; the wing-flapping machine of Leonardo Da Vinci, early European artist and philosopher; one of Lilienthal's first gliders, and the Wright brothers' first successful plane, are interspersed with the latest triumphs of aeronautical engineering.

The NC-4, first American plane to cross the Atlantic, and the Berliner helicopter, representing the present development of vertical flight, are exhibited.

## U.S. Takes All Helium Output

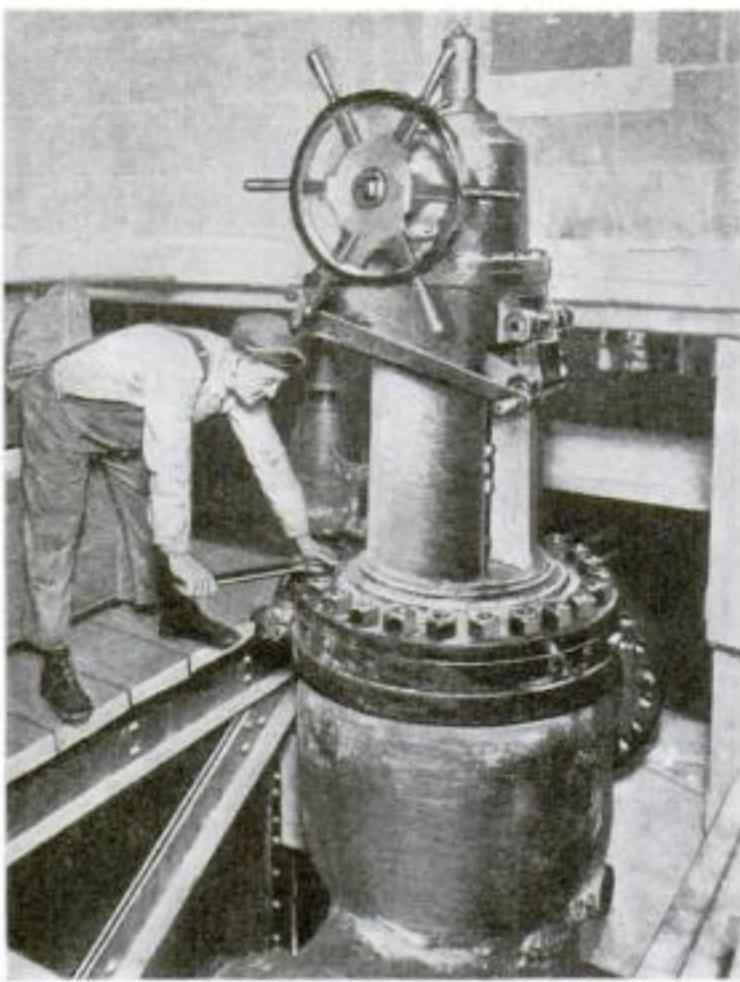
**A**LL the helium that a new plant at Dexter, Kansas, can turn out has been contracted for by the Federal Government. At Fort Worth, Texas, another plant for some time has been extracting the safe, noninflammable gas for dirigibles from natural gas.

More than 100,000,000 cubic yards of helium—enough to fill innumerable airships—is available in the United States' still undeveloped resources, according to Dr. Hugo Eckner, Zeppelin expert. Canada has the only other possible supply in the world yet discovered.

## Upside Down Flying Record

**F**LYING upside down for ten minutes and fifty-eight seconds, a German aviator named Fisler recently established a record at the Zurich, Switzerland, flying field. Official witnesses checked the amazing performance. Fisler landed soon after, apparently free from dizziness.

# One Wheel Rules Power of 80,000 Horses



The world's largest hand-operated steam valve, in a New York Edison Company plant, is controlled by a device like a ship's wheel

## Electric Landslide Alarms

TO PROTECT trains against landslides during the mountain flood season, electric fences are to be tried out in northern California. Wherever a slide appears likely, a wire fence is to be erected and connected in an electric circuit with the block signal system. If a landslide breaks the fence, the electric wires become dead and the danger signals are set along the railroad. In its first test the scheme worked perfectly.

## Gasoline Engine for Freight

UNUSUAL power is claimed for a new gasoline locomotive recently exhibited at Cleveland, O. It is said to pull thirty empty freight cars, or twelve loaded ones, eighteen miles in an hour, using only two gallons of gasoline in this time. Several of the twenty-ton, six-cylinder engines are now in use in one railroad's New York yards, and two larger ones are ordered and under construction.

## Suffocating Goldfish Saved

ARTIFICIAL respiration, often used to revive human victims of drowning, asphyxiation or electric shock, has just saved the life of a goldfish! When Mrs. Robert Bieling, of Schenectady, N. Y., returned to her home one evening not long ago, she found one of her goldfish lying on the floor, apparently dead. Holding the tiny pet under water with one hand, she grasped it with the other just behind the gills and applied intermittent relief pressure. After five minutes of this treatment the fish showed signs of life, it is said, and at the end of twenty minutes' time it was swimming and cavorting normally.

LIKE the steering wheel of a ship is the control wheel that starts and stops power greater than that of 80,000 horses pulling together. Through this valve flows the steam for one of the gigantic 60,000-kilowatt turbines at the East River Station of the New York Edison Company. The power controlled would be sufficient to run all the motor cars that could be packed in neat rows in twenty city blocks. The comparative size of the mechanic working on it gives some idea of the unusual dimensions of the valve, which is the largest of its type in the world.

Thousands of factories are enabled by this turbine's electric power to produce all sorts of commodities for the needs and pleasures of humanity both in New York City and as far as transportation can reach. Homes also, apartment buildings, hotels and office business blocks are lighted by its current.

## Kidnapped by 500-Pound Fish

FIVE hundred pounds of sea bass recently gave Captain John T. McDonald, president of the National Tarpon Association, the fight of his life. He claims it is the largest game fish ever taken with hook and line. The record catch occurred when Capt. McDonald was fishing off the coast of Mississippi, and the fish, which is pictured below, hauled him miles across the Gulf of Mexico before it was finally landed in his boat.



A 500-pound sea bass, called the biggest game fish ever hooked, and Captain John T. McDonald, Tarpon Association president, its captor



## "Plane" for Baby Aviators

NOW any would-be child aviator can have his own "plane"—a toy wagon with wings and tail, that "taxis" over the ground, propeller whirling. Like a real airplane, it is steered with the feet. Pulling the handle back and forth drives the vehicle by a ratchet gear and sprocket chain connected to the single back wheel. A Montana man invented it.

## Biggest Telescope Too Big

WHEN astronomers built the largest telescope in the world, at the Mount Wilson Observatory in California, they made it bigger than necessary. According to Prof. G. W. Ritchey, who designed the reflector with its hundred-foot dome and its hundred-inch mirror, new discoveries show that a forty-foot dome would have been enough. The shorter telescope, he says, would be equally effective. This would not alter the size of the huge mirror that takes the place of a lens.

Another important discovery by Prof. Ritchey is that these mirrors may be built of several separate pieces of glass instead of one huge piece. He has already made them sixty inches in diameter, and says one of thirty feet is possible! The larger the mirror, the more powerful is the telescope, and when the two new discoveries are put to use we may peer into space with stronger vision.

## "Mechanical Man" Gets Angry

ALMOST human is an amazing "mechanical man" that plays chess, the invention of Leonardo Torres y Quevedo, of Madrid, Spain. The lifelike machine can even detect an adversary's cheating, and if this occurs, stops running entirely, as if disgusted at finding his opponent is no gentleman.

Not a full game of chess is played by the automaton, the noted Spanish mathematician recently told the French Academy of Sciences; but it works perfectly with half the usual number of chess men on the board, and responds automatically to the plays made by its human opponent.

## Your Inquiries Answered

NAMES and addresses of manufacturers of products described in POPULAR SCIENCE MONTHLY will be sent to readers on request, if stamped, self-addressed envelope is inclosed. Inquiries should be addressed to Information Department, POPULAR SCIENCE MONTHLY, 250-4th Avenue, New York.



### Chair Folds into Package

FROM a flat parcel of convenient size for packing or storing unfolds this ingenious and comfortable new collapsible chair. Its "legs" are tubular metal rods that swing outward and down to provide a firm base; the seat tilts backward to a restful angle. Arms, seat and back are of canvas. Light in weight, the portable seat is easily carried wherever needed and set up in a jiffy.

### No Peril of World Starving

MAN uses only one two-hundredth of the earth's total yearly food supply, according to a recent estimate by Dr. John M. Arthur, of the Boyce Thompson Institute for Plant Research. All other animal life, big and small, taken together consumes only six times this amount, leaving a huge surplus that makes the possibility of world famine seem remote.

Should some catastrophe blight the world's entire crops, chemists would turn to the manufacture of synthetic food; the only reason they are not making it today, according to the head of Northwestern University's chemistry department, is that vegetable food is far cheaper than any a chemist could make. When food is scarce enough, and consequently high-priced, we may have "laboratory-made" instead of "home-made" apple pie. Meanwhile, the German chemist Haber's discovery of a way to secure nitrogen for fertilizer from the air has assured adequate agricultural food production.

### Snake Myths Spiked

"PLANT repellents" of snakes are a myth, says the Biological Survey. No North American plants drive away serpents by virtue of odor or other cause. The belief that a rattlesnake will not cross a horsehair rope is also scouted.

### Milk Sold by the Chunk

IN SIBERIA'S frigid climate people buy milk solidified and, for convenience, let it freeze around a stick that serves as a handle to carry it. "Don't break the milk," parents of Irkutsk admonish children; but broken milk is easier to pick up than spilt milk. The milkman leaves one or two chunks daily at the home of a customer.

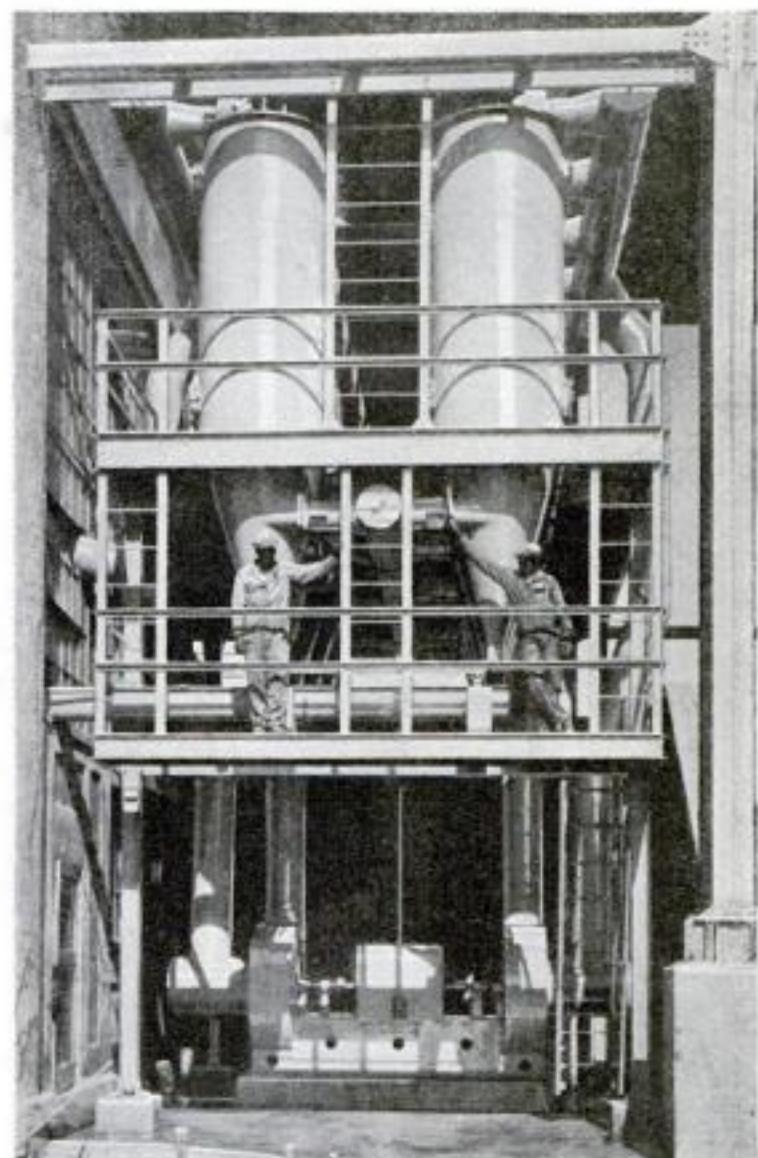
## Removing the Dust from Industry

"DUSTY industries," those which involve treatment of various substances in powdered form in quantities—such, for instance, as the grinding and pulverizing of minerals and the making of such pulverized minerals into commodities—are said to be made over by a new system of air purifying that removes the objectionable particles before they damage the workers' health or escape into the outside air to trouble nearby residents. Special apparatus circulates the dust-laden air through filters that remove the fine powder and return the air fresh and pure.

At a Birmingham, Ala., rock grinding mill the new system made it possible, probably for the first time in history, to place electric motors and even their delicate electric controls in the same room with the grinders which are the source of the dust menace. Now the same plant is planning to surround its mill with grass plots and flower beds, hitherto made impossible by the escape of quantities of thick dust into the outside air.

### Sun Just Starting

FOR a hundred and fifty billion years the sun will continue to supply us with heat and light, according to Charles Nordmann, French astronomer. He bases his calculations on latest discoveries of the atom's construction. This refutes the old idea that the sun would burn out in ten million years' time at the most.



In this rock-grinding plant tubular pipes draw dust-laden air up from the grinders at the base into the large filters above, which keep the dust and return the air pure

### A Paint Gun on a Pole

A PAINT gun on a pole is the latest arrangement to apply a protective covering at high speed to freight cars, ships, high walls or ceilings that are hard to reach with ordinary equipment. By compressed air, controlled through a handle at the base of the pole, the paint is sprayed on in a jiffy, as shown in the illustration at the left, with the greatest economy of time.

### Cats and Dogs Color Blind

CATS live in a gray world. So do dogs, and raccoons. All are color blind, says Prof. F. M. Gregg, of Nebraska Wesleyan University, who tried to teach them to come for meals by colored signals. He succeeded; but he found that when gray signals of equal strength were substituted, the animals behaved in the same way.

### 70,000 Homemade Movies

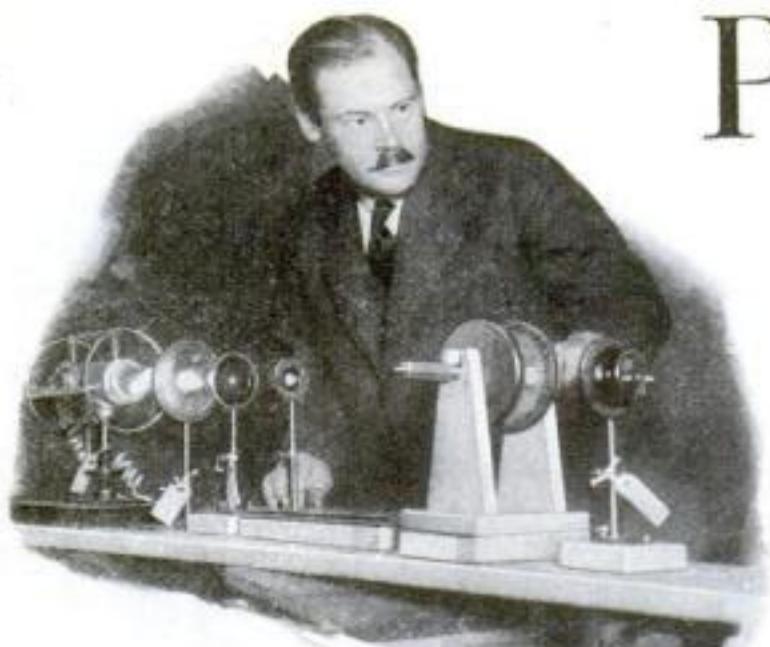
NOW 70,000 amateur photographers in America are making their own movies, according to a recent estimate. How the homemade films rival the popularity of the old family albums of photographs is shown by the fact that fifteen hundred amateurs are enrolled in a New York City cinema league that publishes a magazine. Twelve thousand read it.

In New Haven, Conn., amateurs filmed Fielding's "Tom Jones." A group in Orange, N. J., tackled a full scenario. From such work by amateurs new ideals of artistic photography may develop.



Through a hose, the nozzle of which is attached to the end of a pole, compressed air blows paint in a hurry over inaccessible areas, as shown above

# Pictures from the



## New Television Idea

Dr. E. F. W. Alexanderson, television pioneer, shows a model of a device to receive scenes sent by radio and project them on a screen by means of seven beams of light. Instead of mirrors, as in previous models of his system, this machine would direct the light rays with a prism

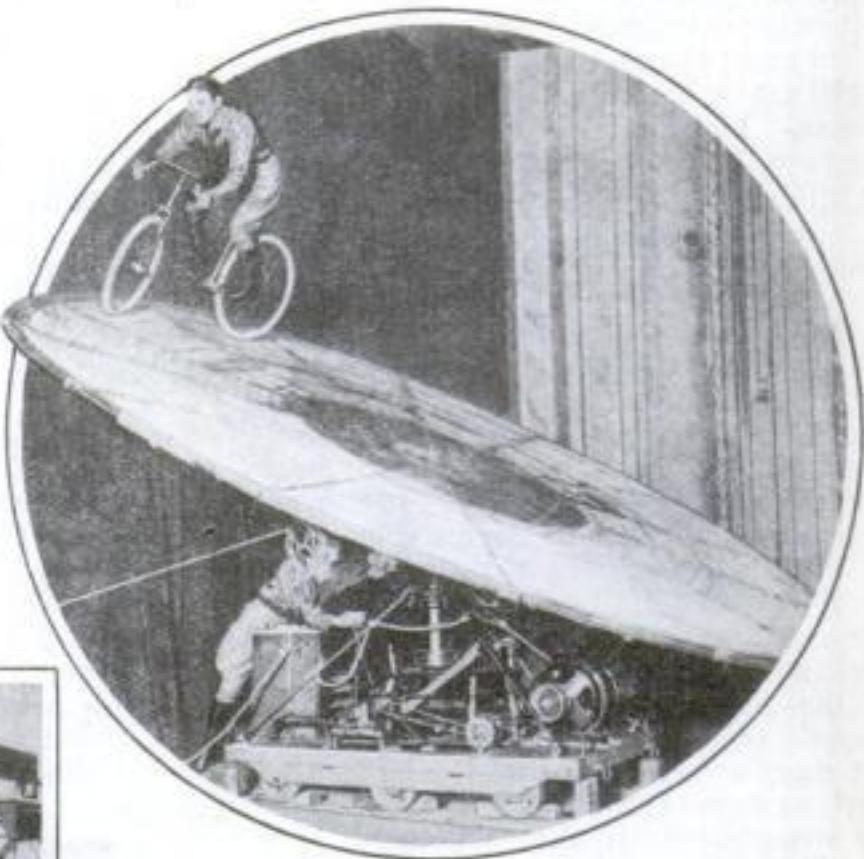
## A Sea Thermometer

To learn more about ocean currents, this machine, developed at the University of California, is attached to a ship's intake pipe, far below the surface. Water temperature affects it through the glass and the degrees are recorded automatically on a chart. The temperature identifies some currents in the ocean



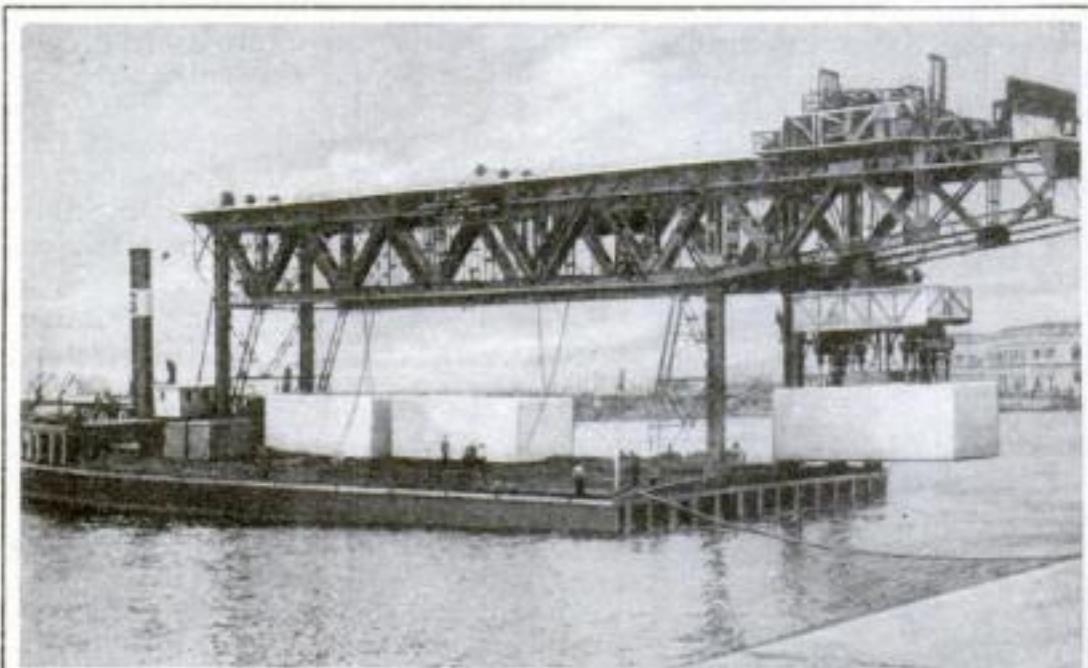
## Operating on a Dragon

In the London Zoo's reptile house recently this eight-foot East Indian lizard, called "dragon," was operated on for a mouth infection. Here he is seen gagged by a rule thrust into his mouth, lest he bite the doctor

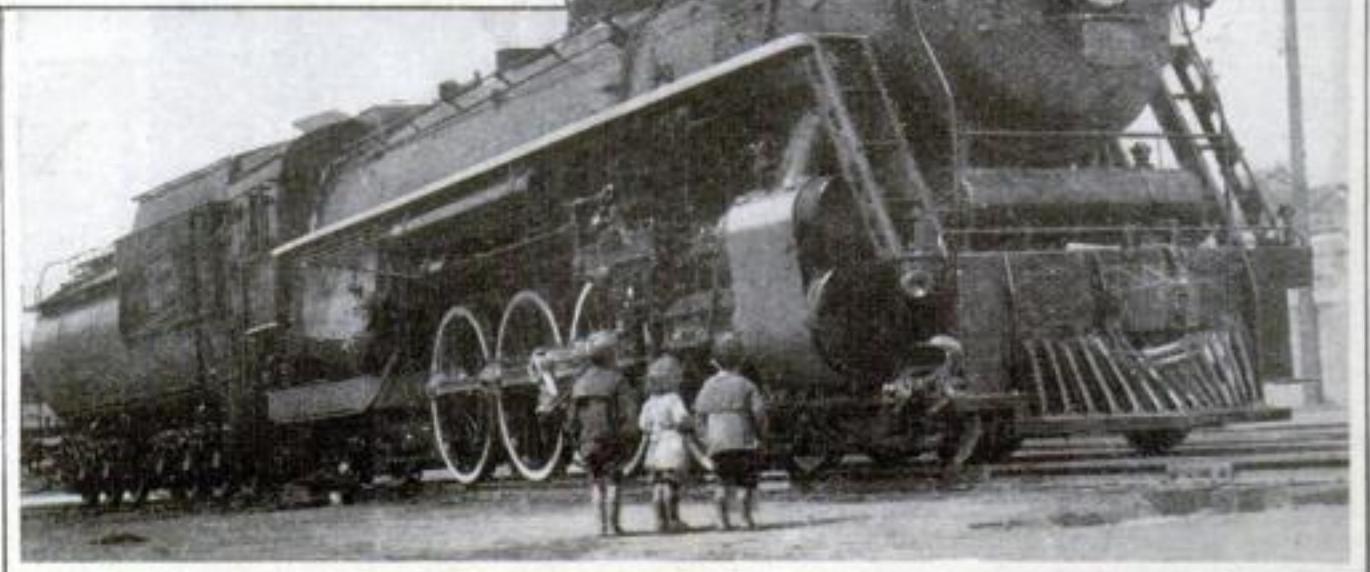


## Turntable Cyclist

In the latest Berlin Winter Garden thriller a bicycle rider, Catalini, pedals at high speed around the rim of a revolving turntable. The table, operated by an electric motor, tilts in various directions while the audience watches breathless



**A Pontoon Crane** The largest floating crane in the world, recently completed in Italy to aid in building the new docks at Eari, moves 350-ton blocks from its own pontoon to their places on the shore. Great economies have been accomplished by this method of building on the land from the water



**Super-Locomotive** This is the first of a family of fifty new locomotives ordered by the Canadian National Railways, which are called the greatest engines in the world. It weighs 326 tons, is ninety-four feet six inches long, has 250 pounds steam pressure to the square inch and develops more than thirty-two hundred horsepower

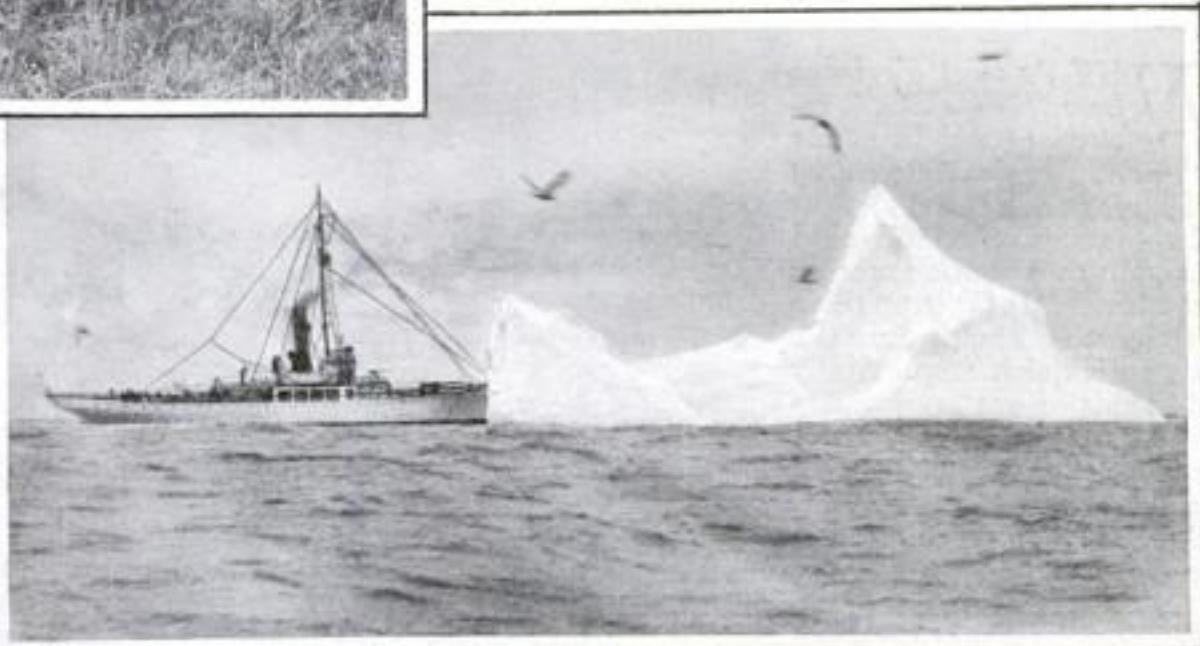
# World's Scrapbook



**Life-Saving Rocket** The Schermuly life-saving rocket, with which British merchant ships have been equipped, is here being tested by Members of Parliament, one of whom, A. G. Ammon, is about to fire it. The rocket, discharged from a big pistol, carries a rope to a drowning man or to a ship in peril. With this rope a larger one may be drawn to the vessel and thus rescues by breeches buoy accomplished easily and quickly



**Official Candy Eater** The nicest job in the world for a girl is that of Miss Catherine Carabine, who sorts and tests candy for the U. S. Department of Commerce in a national survey of the confectionery industry. Here the nation's professional "sweet tooth" is seen hard at work on samples which have just come to her desk in Washington. Don't you envy her?



**Ship Flirts with Iceberg** The U. S. Cutter *Modoc*, on patrol duty, has little fear of icebergs, and in this picture seems to be ramming or rubbing noses with one. Actually, the prow is a safe distance behind the berg. This deceptive photograph was taken recently from one of the *Modoc*'s gigs. Seven eighths of the berg in the picture is submerged



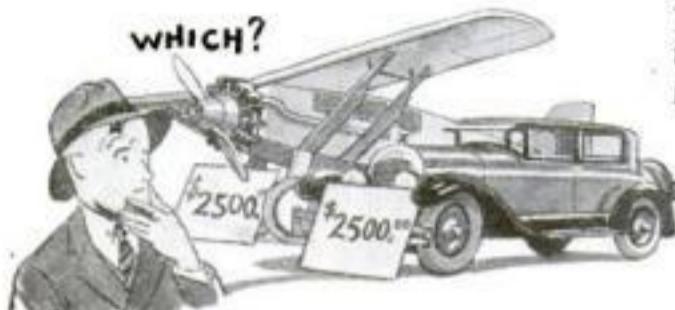
**Largest Mobile Gun** The largest piece of mobile artillery in the world is the 14-inch gun, mounted on a railroad truck, that is part of the Los Angeles harbor defense. Below are seen the projectiles which it can hurl thirty miles. In recent tests this military "loudspeaker" fired at targets that were located more than fifteen miles out at sea



**Autos Play Leapfrog** Hurdling one motor car with another is the stunt with which M. Mercui, Belgian dare-devil, entertains thrill-seeking throngs. In the jump photographed, made in a run off a short ramp, the driver rose more than six feet and the length of his leap was more than sixty-five feet. The machines used are specially built for the purpose. The hard landing after flight would smash to bits most ordinary automobiles used in passenger service

# Your Aviation Questions~

What Will My Plane Cost Me?—Why Can't Flyers Land in Fog?—Why Don't Tail Skids Drag in Taking Off?—These and Many Other Queries Answered



Byrd's plane cost \$80,000, but you can get one for yourself for the cost of a good car

**WHY** do most airplanes have "tail skids," instead of wheels, at the back—and why don't these drag and cause trouble?

In landing, the tail skid acts both as a shock absorber and a brake. It takes up some of the jolt and helps drag the craft to a quick stop. Many tail skids have adjustable hooks that dig into the ground and exert a strong braking force. When the plane begins to take-off, however, its tail immediately goes into the air and does not drag.

*Why can't a plane come down in a fog?*  
AIRPLANES must land while flying at fifty to a hundred miles an hour. At this velocity it would be almost certainly fatal to graze an invisible earth, perhaps covered with trees and rocks.

*What is an airplane's "cruising radius"?*  
The total distance in miles an airplane can fly on its gasoline supply. Unavoidable deviations from its course make the straight-line mileage a plane can safely attempt less than its cruising radius.

*How far has long-distance flying advanced in twenty-four years?*

The nonstop record made by Wright in 1903 was 852 feet; that of Chamberlin, in 1927, was 3,905 miles.

*Have airplanes any practical value, aside from military and air mail use?*

PURSUING smugglers' airplanes and observing eclipses are among the 156 uses reported in the October POPULAR SCIENCE MONTHLY. Only thirty-two of these uses are classed as military; others are agricultural, municipal, commercial and scientific.

*How much does an airplane cost?*  
The huge tri-motored Fokker monoplane Commander Byrd used on his trans-Atlantic flight costs about \$80,000. Lindbergh's Ryan monoplane cost \$18,000 and Chamberlin's Bellanca, \$25,000.

Private flying craft may be bought from \$2,000 up, starting at about the price of a good automobile.

*What do airmen mean when they speak of (1) "the gun"? (2) a*



Why airplanes can't land in fog. For the reason that it obscures the ground and aviators cannot risk wrecking craft on rocky or wooded terrain

"rubber cow"? and (3) "zooming"? (1) The gas throttle; an aviator "gives her the gun," as a motorist "steps on the gas." (2) A balloon or dirigible. (3) Climbing sharply upward and then descending; a pilot "zooms" over an obstacle.

*Could a land plane, falling into the sea, take off again if the motors were undamaged?*

**N**o. Its wings dragging in the water, a land plane could not gather enough speed to fly and would speedily sink.

*How are airplane height records measured?*

By reduced air pressure, as recorded by



Spraying a field by airplane with chemicals to destroy pests that menace crops—one of the hundred and fifty-six recorded uses of aircraft that range over varied fields of war, science, agriculture, commerce and municipal maintenance

a sealed barometer. This pressure decreases fairly steadily with increasing height; and on this fact the Federation Aeronautique Internationale, world arbiter of air records, has established a standard formula for computing altitude from the barometer reading. Similar barometers, sealed before a nonstop distance flight attempt, reveal whether the pilot landed en route.

*Could an airplane run by steam instead of by a gasoline motor?*

**Y**ES, provided an efficient enough steam engine could be found.

In a heavier-than-air craft every ounce of excess weight must be discarded. Modern gasoline motors best fulfill the necessary compromise between great power and light weight; but designers may adapt a steam engine to airplanes. Fuel oil or gasoline would probably be used instead of coal as both have a higher heating value per pound. The load of water required for steam would be a disadvantage.

However, a New Jersey inventor is now planning an eight-ton airplane for a proposed trans-Atlantic flight attempt, driven by two steam turbines.

*Can modern planes fly in storms?*

**T**ODAY'S pilot need fear only the most severe storms; and these he can generally ride around. One of the outstanding lessons of Byrd's historic flight was that we have learned to build planes that will fly through the worst of storms. Only fog remains as a landing danger; and this calls for improved guiding beacons and instruments, rather than better planes.

*What has become of the helicopter, thought by many to be the ultimate form of airplane due to its direct vertical flight?*

Since January, 1924, the U. S. Patent Office has granted inventors twenty-three patents on helicopters.



The advance of twenty-four years in nonstop distance flight. What will the next twenty-four show?

# Making Beginners Radio-Wise

# How to Shield Your Receiver

## Fine Points in Eliminating Hum—New Resistance Unit

HALF-HEARTED attempts at shielding a radio receiver usually get the amateur radio constructor into trouble. Shielding, to be effective, must be carried out in a very thorough fashion. This means that each individual stage of radio-frequency amplification should be surrounded with an unbroken metal wall. Even a hole no larger than a quarter of an inch may result in undesirable coupling between stages.

The home construction of such complete shields out of sheet metal means a lot of work, especially if you use the heavy gage aluminum, brass or copper which have proven most effective for shielding purposes.

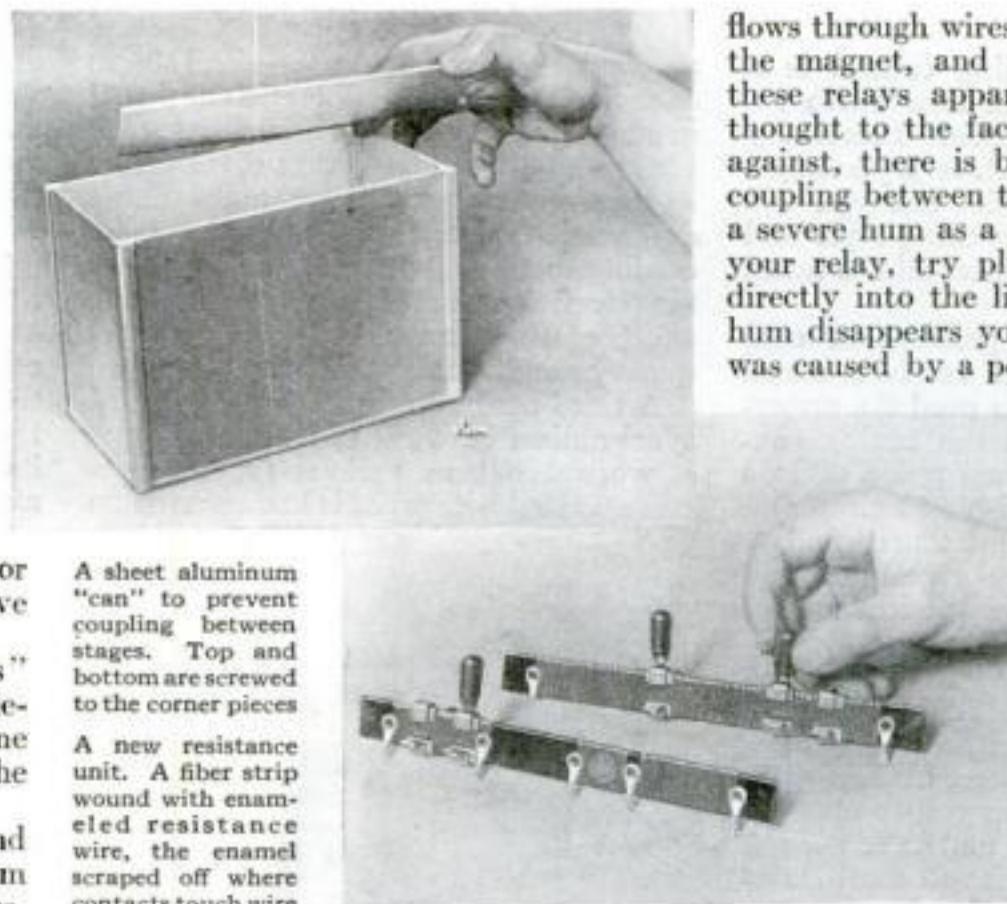
Fortunately, several types of "cans" are now to be found on the market, designed especially for radio shielding. One of these prepared shields is shown in the upper illustration on this page.

The corner pieces are quite heavy and are grooved so that the plates that form the sides are slipped into these grooves. The top and bottom are held on by small screws turned into tapped holes in the corner pieces. The material is heavy sheet aluminum. No holes are provided for condenser wires. These you will have to drill yourself to fit the parts you use inside the shield and the wiring diagram you follow. This is good arrangement because it permits you to have the holes exactly where you want them. Aluminum is easy to drill.

### Queer Sources of Hum

SOMETIMES a high-grade B-battery eliminator gets blamed for a bad hum when the eliminator is not at fault. Almost any type of B-eliminator will produce a bad hum if it is not properly grounded. In most cases the necessary grounding is effected when you connect the minus B wire from the radio receiver to the B-eliminator, but some receivers are wired in such a way that the filament circuit of the receiver is not connected to the ground wire of the set. And while the B-minus wire is always connected to the filament circuit, with a receiver wired in this way the B-eliminator is not properly grounded.

The remedy is simple. Merely connect a wire between either the plus or minus A binding post on the receiver and the ground binding post. Before putting in this connection, however, make sure that the filament circuit is not already grounded. You can do this by connecting a two-candlepower six-volt auto bulb between first the minus A binding post and the ground post and then the plus A binding post and the ground. If the bulb



A sheet aluminum "can" to prevent coupling between stages. Top and bottom are screwed to the corner pieces

A new resistance unit. A fiber strip wound with enameled resistance wire, the enamel scraped off where contacts touch wire

lights in either case, the filament circuit is already grounded and the hum is caused in some other way.

Automatic relay switches often are an unsuspected source of hum. In these devices the current that supplies the filaments of your vacuum tubes is carried through the windings of the magnet that operates the relay. The alternating current used to operate the B-eliminator also

flows through wires and contacts close to the magnet, and the manufacturers of these relays apparently have given no thought to the fact that unless guarded against, there is bound to be magnetic coupling between these two circuits with a severe hum as a result. If you suspect your relay, try plugging the eliminator directly into the light socket and if the hum disappears you can be sure that it was caused by a poorly designed switch.

Placing the eliminator too near the radio receiver often causes a hum. If you can't locate the trouble anywhere else, try moving the eliminator several feet away from the receiver.

### Useful Resistance

RESISTANCE, electrically speaking, is that property of an electric conductor which retards or decreases the flow of electric current. In many parts of a radio circuit resistance is detrimental and results in broad tuning, but there are many places in the radio receiver and its accessories where resistance is absolutely necessary. The value of a resistance for radio use depends on its accuracy and also on whether the resistance will remain a fixed quantity over a long period of time. In addition, the value of a resistance is determined in many cases by its ability to carry heavy currents without undue heating or changing in value. The growth of radio has created a demand for many types of resistance not previously in use in any other branch of electrical work. The resistances used in B-battery eliminators are of this type. They must stand up under high voltage and heavy loads, yet must be compact and of permanent resistance value.

The lower illustration on this page shows a new type of wire-wound resistance especially designed for use in controlling the voltages of B-eliminators. Fiber strips are wound with enameled resistance wire and the enamel is scraped off along one edge so that the movable contacts touch the bare wire.

Resistances designed for use in B-eliminators should possess high resistance combined with high current-carrying capacity. It is easy enough to obtain any desired high resistance for use with feeble currents but when heavy currents are passed the heat generated affects the value of the resistance and ruins it unless it is designed to carry the load.

### A B C's of Radio

FREQUENTLY poor tone quality in a radio receiver is due to a defective detector tube or a good tube working under the wrong conditions. The value of the grid leak is important. If the resistance is too high the tube will distort on any loud signal, although it will be somewhat more sensitive on weak signals. Operating the detector tube with the filament below normal brilliance also causes distortion. The detector B voltage should not be too high or too low. Try raising and lowering it to make sure it is right for the tube you are using.

The detector tube is very critical to poor filament contacts. If the socket springs do not make perfect contact with the tube prongs considerable noise will be produced that sounds much like static.

No matter what kind of set you have, if several 201A type tubes are available, try each one as a detector, because tubes vary slightly in the tone quality they produce.

# All About Single Dial Control

*Things You Must Know to Operate a Set with This Feature or to Build Your Own*

By JOHN CARR

**S**INGLE dial tuning control is a feature of all the new radio receivers this season. Practically every model has it. So if you buy a complete receiver or build one you will want to follow the prevailing style and have a single dial to control all the tuned stages.

At first glance, the problem of constructing a single dial receiver seems simple enough. All you need do, apparently, is to mount all the tuning condensers on one shaft, and put a dial on the end of it. But it isn't as simple as that. The radio set manufacturers and amateur builders have encountered many difficulties both electrical and mechanical.

Whether you buy or build a single dial control set, you will find it worth while to know what these problems are and how they have been overcome. The knowledge will help you to operate a factory-built set and take care of it in such a way that it will continue to give as good service as when new. And if you contemplate building a receiver of this type you will want to know how to avoid the pitfalls that lie in your path.

**D**IFFICULTIES with single dial control are either of a mechanical or of an electrical nature.

The principal mechanical problem is in building the several condensers and coils so precisely alike that they will tune to the same station when the plates of the condensers are set at the same angle. If there is an appreciable difference between the various condensers, for instance, you may find that the set does not tune accurately. There will be no exact point at which any station can be found. The broadcasting may be received equally well over a space of two or three degrees on the dial even for a weak station. When this condition is very bad there may be two or more distinct points close together where the station seems to be received with maximum volume. Of course, the same conditions can exist if the tuning coils are not alike.

One way in which this trouble can be overcome is to use small vernier condensers for the fine tuning and depend on the main dial only to locate the station. Some manufacturers resort to this practice and amateur set builders also find it a simple way to compensate for lack of uniformity in the various parts or in the wiring.

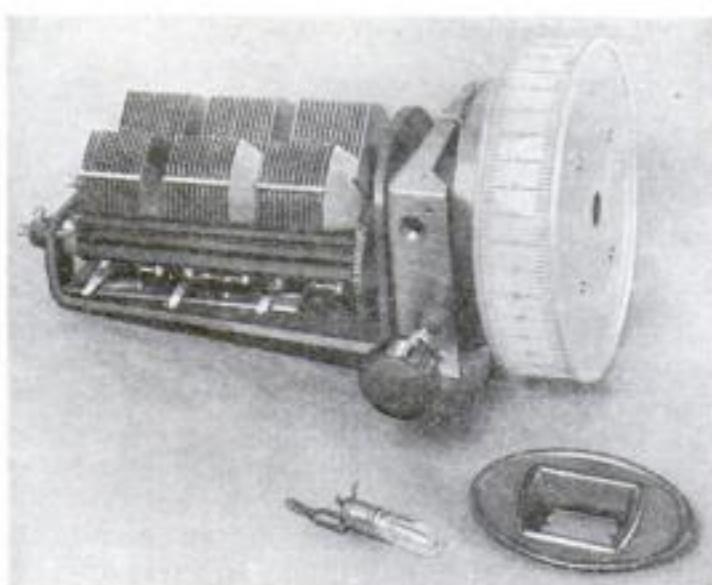
Another way around this

particular obstacle is to use several stages of radio-frequency amplification designed in such a way that each individual stage tunes rather broadly so that slight errors in any one stage will not make much difference. Receivers properly built according to this method give good results for selectivity because of the cumulative effect of the many stages of radio-frequency amplification.

A third method of overcoming lack of synchronism between the various stages is worked out in various types of receivers fitted with what is known as drum

arrangement gives you most of the advantages of the true single dial control and simplifies the problem of the commercial or amateur builder of the receiver.

If you buy a modern receiver equipped with single dial control you may not be interested in just how the maker solved the problem of synchronizing various stages of tuned radio-frequency amplification, but you will want to know what treatment on your part is likely to throw the set out of adjustment and so decrease its ability to bring in distant stations and perhaps spoil the tone quality as well.



A novel triple condenser for the amateur builder. It mounts with the shaft parallel to the panel to take advantage of the drum control. A screw driver adjusted vernier condenser is built into each part for synchronizing

control. In these sets a revolving drum set edgewise to the panel is used instead of a dial parallel to it. With this construction it is simple to arrange two or three drums side by side. For tuning local stations and finding the more powerful distant ones, the three drums are turned by the fingers as a single unit and then fine adjustments are made by turning each drum separately. This

like any other piece of accurately adjusted machinery, your single dial control receiver is particularly susceptible to severe jars and bumps. It is quite possible to spoil the synchronism of the tuning control just by allowing the set to slam down on the table when you move it from one place to another. And if your set has been shipped to you from the factory there is a possibility that it has been severely jarred during transit. However, manufacturers guard against this possibility by packing receivers in fiber cases specially designed to resist shock. And consequently if the receiver has received a jar during transit sufficient to damage it, the marks of the accident undoubtedly will show on the outside of the package.

Rough handling of the tuning control often will cause trouble. Be sure to handle the control knob carefully.

It is occasionally desirable to dust out the inside of a radio receiver. If your set is of the fully shielded type there isn't much chance for trouble, but if the tuning condensers are exposed, be extremely careful that you do not strike the plates with your hand or the cleaning instrument. One bent plate may change the tuning of that particular stage sufficiently to spoil the accurate tuning qualities of your receiver.

These, of course, are mechanical points that will appear somewhat obvious to you if you are mechanically inclined, because you will realize the importance of taking proper care of a mechanism as fine as the modern radio receiver. But there is an electrical effect that has caused much trouble for owners of single dial sets. It is the variation in electrical capacity between different makes of radio tubes. The elements in the tube are part of the tuned

## Watch These Seven Points:

1. Buy only an approved type of single dial control receiver.
2. Make sure that it has not been damaged in transit.
3. Handle the controls as carefully as possible.
4. Avoid odd tubes in the radio-frequency stages.
5. Follow the manufacturer's recommendations on tubes.
6. Never allow the receiver to be subjected to rough handling.
7. Do not tinker with or make any changes in the tuning mechanism.

circuit of each stage of radio-frequency amplification, and if, for instance, you replace a tube in the set with a new one of different capacity, the tuning point for the variable condenser on any given wave length may be shifted as much as a degree or two.

This means that it is vitally important to use standard tubes all of the same make in every radio-frequency stage of your amplifier. One odd tube, no matter how good it may be when judged on its own merits, probably will upset the tuning and perhaps the balance of the entire receiver. You will do well to follow the set manufacturer's recommendations as to the proper tubes for your receiver.

These are the important points for you to remember if you purchase a factory-built single dial control radio receiver. If you start in to build one for yourself your principal problem will be to get it synchronized.

**T**HE first difficulty to overcome is that of making the first tuned stage, the one that is directly coupled to the antenna circuit, tune the same as the following stages. If you have handled the conventional receiver with individual controls for each stage, you already have noticed that the first dial always seems to tune-in stations at a lower point on the dial than the other stages, and that this difference is much greater at the shorter wave lengths, or in other words near the lower end of the dial.

Also, you may have noted that this effect becomes more pronounced if the length of the antenna is increased or a larger number of turns are used in the antenna coil in the receiver.

There are two ways to get rid of this trouble. One is to connect all the tuned stages except the first to one dial and use a separate dial for the first stage. Another is to use an extra vacuum tube to isolate the antenna circuit from the first tuned stage so that it can have no effect on it. The latter method has much to recommend it, now that the cost of tubes has come down to a low figure and the current supply problem is taken care of by trickle chargers for the A circuit and B-eliminators for the B potential.

**A**ND ISOLATING tube can be added to any conventional type of wiring diagram with extra apparatus except a 201A type tube, a socket, a rheostat and a radio-frequency choke coil. The filament circuit is wired up like the other tubes in the set. The antenna is connected directly to the grid terminal of the tube socket. The coil that, in the original diagram, was connected to the antenna and ground is now connected to the plate terminal of the tube and to the wire from the B-batteries or B-eliminator

that also serves the rest of the radio-frequency amplifier stages. Connect choke coil between antenna and ground. Make sure that the filament circuit is grounded. No additional amplification can be expected from the extra tube on normal antennas, but you may notice a slight increase in signal strength on short outdoor antennas and indoor antennas.

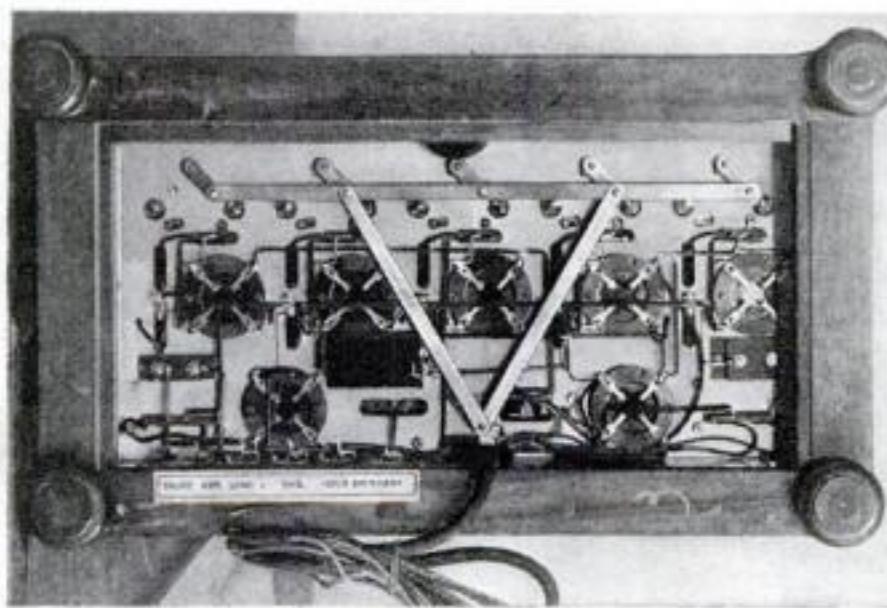
You will find it worth while to buy factory-wound tuning coils rather than



One of the latest factory-built single dial control receivers has the dial mounted on a vertical shaft with the beveled and numbered edge protruding through the panel. The operating knob is mounted below it

to make them yourself for use in constructing a single dial control receiver because it is extremely difficult to wind several coils in the home workshop that will tune precisely alike.

Only high grade, matched variable condensers should be used, and if the condensers are fitted with a means for varying the capacity slightly to match the circuits to each other after you have completed the whole receiver, so much the better. If the condensers have no such micrometer arrangements for balancing, you will find it worth while to fit a midget condenser in parallel with each full-sized tuning condenser. These smaller



Here is the working mechanism of a new receiver with five tuned stages controlled by a single dial. The connecting rod and lever arrangement that couples all tuning condensers to the common control shows clearly

condensers, however, need not be mounted on the front panel if you expect to use them only for synchronization.

While the radio manufacturers are in a position to build special link motions to couple all the tuning condensers to the same dial, this method is not recommended for the amateur builder unless he is an expert mechanic. A beautiful example of this method of coupling the

various condensers is shown in one of the illustrations, and it is easy to see how accurate the workmanship must be to give satisfactory results.

If you are building a single dial control set, use either a gang condenser with all the individual condensers built into a single unit on the same shaft or else use individual condensers and couple the shafts end to end to a drum or dial control, depending on arrangement.

Great care must be taken with the arrangement of the apparatus and with the wiring. Try to have all the parts that constitute each stage of radio-frequency amplification arranged in exactly the same way so that the wiring of each stage will be a sort of a rubber stamp repetition of the other stages.

Of course all the condensers should be of exactly the same make and size. Even the sockets should be of the same type and make.

The more stages of radio-frequency amplification you attempt to control by the same dial, the more difficult it will be to get them properly synchronized, and with a multistage outfit one of the principal obstacles will be to know when the synchronization actually has been accomplished. Among many stages, one may be several degrees out without the over-all tuning being affected to a very noticeable degree, although of course there will be falling off in sensitiveness and also in selectivity.

**I**F THERE are several powerful stations near by, you can use the signals received from these stations to help you synchronize the set. Select a low-wave station and tune it in to maximum volume. Then turn down the volume control until the signal is quite weak and see how much you can increase it by changing the setting of the small vernier condensers if they are part of the circuit. If there are no small synchronizing condensers, you may find it possible to loosen the condensers from the control shaft sufficiently to turn them individually. Repeat the process on a high-wave station.

A single dial control receiver in which each stage of radio-frequency amplification is completely shielded has some features that recommend it. Because the tuning coils are shielded, they can be placed in exactly the same position for each stage, and this means that the grid and grid return wires are all of uniform length and in the same relative positions.

Furthermore, the complete shielding helps to prevent stray capacity effects which might change the tuning of one or more stages. Remember, also, that adding stages of radio-frequency amplification beyond one or two means additional difficulties in electrical balancing to prevent oscillation.



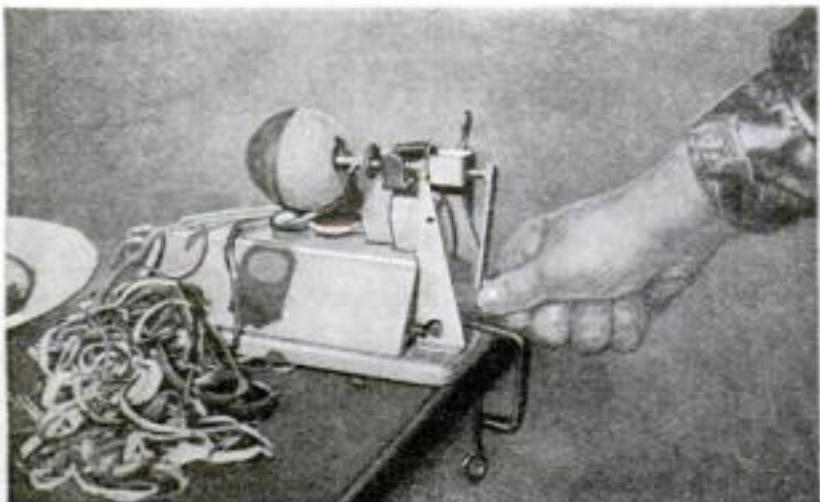
An end of loose and rattling door knobs is promised by a new spindle, which, instead of being round, has long grooves or angles, which firmly grip the set screws that fasten the knobs. They are easily installed and last a lifetime



A business-like way to extract orange and other fruit juices. Press the halves against the reamer in the upper part, which you turn once and a half by the crank on the outside. The juice falls through a strainer in the bottom of the device into the cup below. The machine screws to a kitchen wall. The reamer is removable for most effective cleaning



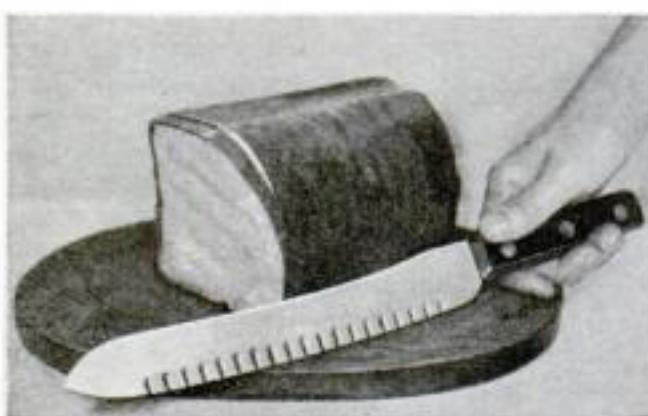
A kitchen cabinet that brings the electric stove as near as you could wish to the materials you cook with it is here shown in use. This latest space-saving range sets atop the white enamel cabinet, which has cupboard and drawers and a mixing and general work board that pulls out



On the order of an office pencil sharpener is a new German fruit parer, which you attach to the kitchen table at preserving time. Put the fruit in position by running the shaft through its core. Then turn and the cutting mechanism removes the skin more speedily and more uniformly than the hand equipped with the old fashioned paring knife and with no danger of cut fingers



One of several new designs of tea strainers avoids all danger of spattering by having the tea drop through wire mesh into a cup below, which is equipped with a spout for pouring into the teacup. The spout cup can be easily removed to clean



Fresh bread and light sponge cake have always been difficult to cut, even with the sharpest knife. Here is an invention that is said to overcome the difficulty. While the entire bottom edge of the blade is sharp, so are the edges of the slots cut in it. Thus you have a series of knives in one, and the cutting power of the clever device is said to be greatly increased



Stainless egg spoons are among the latest devices to reduce the worries of housewives. Looking like silver and artistically designed, they are made of a metal alloy that does not tarnish. They wash instantly and require no polishing nor scouring



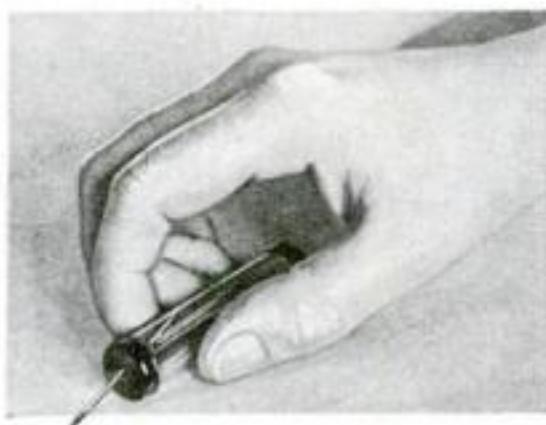
This porcelain disk, placed in the bottom of the cooking utensil, is declared to produce the effect of stirring and prevent burning of milk, cocoa and other liquids. A spiral groove on the side that rests against the bottom, starts in the center and ends in a hole at the edge. Vapor formed in the groove keeps moving out, the liquid with it, forming a stirring effect, and a jet bubbles to the top, constantly agitating the liquid

# Housewife in Her Tasks

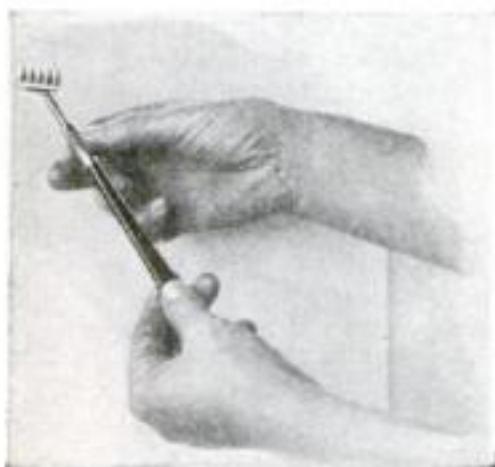


Washing windows on the outside is made simple and safe by a novel "window insert" which consists of a hinged frame for one pane in the sash. Opening this pane gives access to its outside and those of the other panes. Necessity of removing screens is obviated. The insert also permits ventilation of the room without the need of opening the entire window

Here is a needle case of glass, whose metal core is ribbed, making compartments for needles of various sizes. One end cap with a small hole rotates to let the hole form an outlet for the needle desired. A pointer indicates the size. Another end cap fits on the case when not in use. It protects the needles from rust



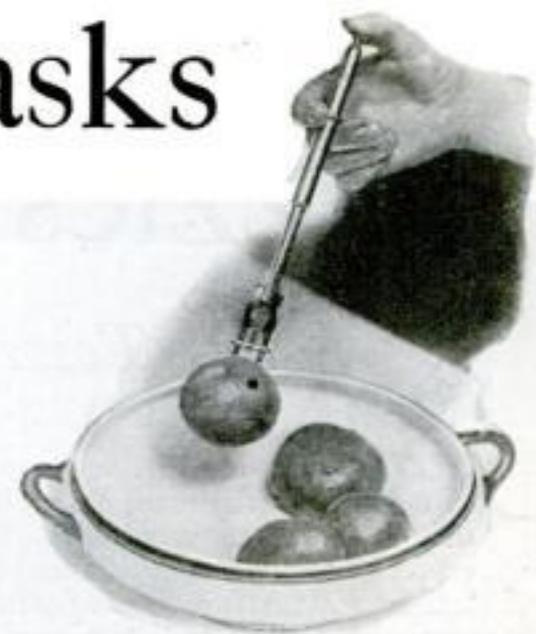
Spoon and fork are combined in the unique utensil below, whose capacious bowl is extended into three prongs. Vegetables can be stirred and with the same instrument those that are done can be speared and taken out, conveniently leaving the others to continue boiling



Adjustable to any position with relation to the handle is this new toothbrush. Hence it is said to enable the operator to reach every corner and crevice of the teeth, outside and inside, as well as the plain open surfaces. It also makes easy the up-and-down brushing, recommended by dentists and difficult with the ordinary brush. A twist alters the position. New brushes can be had to fit the old handle



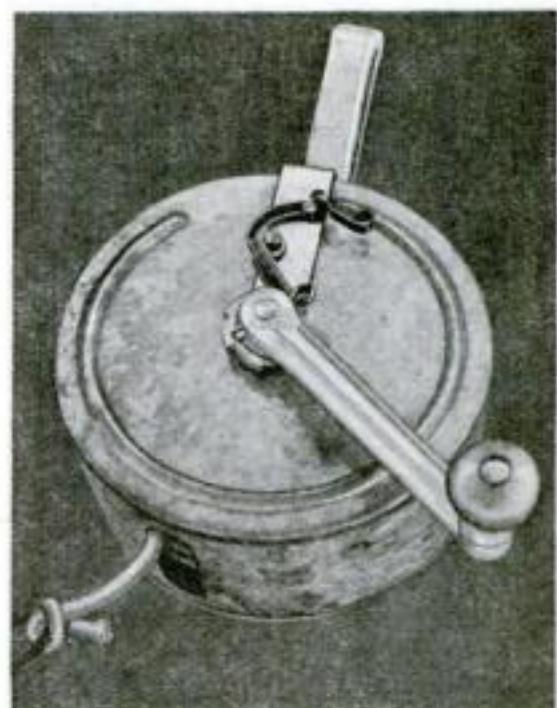
Notes for the milkman will not get lost when left in this milk bottle cap, whose inventor has just obtained a patent. Coins also can go between the two paper disks, which are fastened with a rubber band and fit into the neck of the receptacle. The band holds the device securely in its position



Press the plunger at the end of this fork for serving olives, pickles or vegetables and the other end of the plunger moves down the device which pushes the article off the tines—a much daintier and almost as simple a method as that of using the fingers to lift off the delicacy or scraping it off on the edge of the plate, letting it drop



Another of the new tea strainers which add a dainty charm to a luncheon. The arrangement, in the form of a hinged circle, fits over the cup. Set it on its side after the tea is poured and the hinge lets the strainer part tilt, emptying out the leaves



The ratchet device on this improved clothesline reel for kitchen or back yard enables one to raise, lower, loosen or tighten the line without props. The ratchet holds it exactly as wished. The 100 feet of line is protected when not in use by the metal shell and can be replaced when worn out. Hang the clothes on a low line, then turn the crank and raise them to any height desired

# Sam Loyd's Mental Gymnasium

# Puzzles to Polish Your Wits

## Six Tests of Speed and Accuracy in Thinking

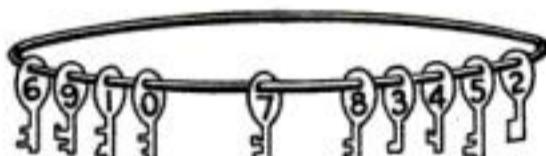
Puzzles that are distinctive and of actual value, because they not only provide entertainment but exercise and train the mind to think straight and fast, are presented here each month by Sam Loyd, the world's most famous puzzle maker. Test your capabilities with these problems. Record the time you require. Then turn to page 144 for your rating in speed and accuracy.

R  
Xss DK

### A Rebus Remedy

THE medicine that you need," said the old medico to his friend who had been burning the candle at both ends, "is a blunt warning. Just concentrate on this prescription, and the labor of deciphering it will help to impress upon your mind the errors that have led to your condition."

See if you can translate the doctor's advice. It is given on page 144 with the time within which you should decipher it in order to get a good rating.



### A Puzzling Key Ring

SOMEBODY has been meddling with my keys again," complained John the janitor as he scrutinized his ring of keys on the wall. "That fellow thought he was clever, too," mused John, "for he left the keys as I had them, in three groups. But he was not smart enough to notice that the number of my first group multiplied by the middle number would produce the number of the other group."

Who can mentally shift these keys around so that they will form an arrangement of three groups which will conform to the description as given by the janitor?

If you can do so within the time given with the answer on page 144 you are clever enough at figures to go to the head of the class.



### What Was the Age of Fido?

BIG sister's beau and brother Johnny were discussing the family dog when, in response to an inquiry as to the animal's age, Johnny vouchsafed the following rather puzzling information:

"I don't know, but five years ago sister said she was four times older than Fido, and this morning she said she was only three times as old."

Charlie Slowpop is anxious to know Fido's age. Who can tell him?

The answer with the time allowed to find it is given on page 144.

### Trading Livestock

THREE drovers met on the highway and proceeded to dicker as follows: Said Hank to Jim: "I'll give you six pigs for a hoss; then you'll have twice as many critters in your drove as I will have in mine."

Said Duke to Hank: "I'll give you fourteen sheep for a hoss; then you'll have three times as many critters as I."

Said Jim to Duke: "I'll give you four cows for a hoss; then you'll have six times as many critters as I."

Who can tell just how many animals there were in each of the three droves?

The answer to this simple problem and the time for solving it are on page 144.

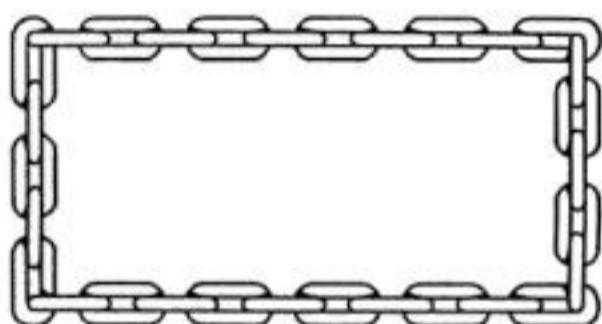


### A Test for Nimble Wits

"HERE is a little chain that I use to shackle fellows who give off-hand opinions without thinking," said the automobile mechanic. "You see it is a continuous piece of thirty links, and the proposition I put to the man whose ingenuity I am trying out is something like this:

"How much will it cost to have that chain cut into six pieces of five links each, assuming that the job will cost on the basis of ten cents for cutting through a link and fifteen cents for soldering the link together again. If I can buy six five-link pieces new at twenty-five cents each, will it pay to have this chain cut up? Which is the more economical investment? Better not give snap judgment; figure it over a bit."

The man's little poser, illustrated below, is a tryout of one's capacity for original investigation rather than an arithmetical exercise. See if you can catch the point and figure it out. Then turn to page 144, where the correct answer and the time limit for the solution are given.



### A Mystifying Race

TABBY and Sport, a cat and a dog who preferred to test their superiority by athletic prowess rather than by the ordinary cat-and-dog warfare methods, ran a race from a tree to a stake and back, a distance of seventy-five yards. Sport sprang five feet at one bound and the cat only three feet; but then Tabby made five springs to Sport's three; so what should be the result of the race?

Now, in answering that question don't jump at conclusions. Remember, Tabby and Sport made only full-length jumps and springs, and maintained their respective gaits throughout the race. The round trip between tree and stake was exactly seventy-five yards.

To prove astuteness in mathematical deduction, answer that question in the time given on page 144, where the solution also will be found.

Another page of Sam Loyd's puzzles to test your mental abilities will appear in next month's issue of the magazine.

# Whole Rooms That Fold Up

*Sleeping, Cooking and Dining Equipment and Even Stairs Fit into Walls and Ceiling*

By JOHN R. McMAHON

"I AM one of those self-made architects," said Ed Martin to an old-time friend he happened to meet, "and I planned our house. It suits me pretty well, but every little while Sue drops a remark that self-made and alibi are a pair of twins."

"What does your wife criticize?"

"Oh, this and that, according to season. Her biggest knock is that we have no stairs to the attic. A lot of storage room gone to waste, because nobody wants to go up and down a ladder with a trunk or a back-load of furniture. I tell her stairs would be fine but the space for 'em just naturally slipped out of my plans. Space was missing when we got to the second floor. You have to have dimensions to put stairs into. No dimensions, no stairs. The best architects make mistakes, I tell her."

"BUT they often fix them up, Ed," remarked the friend. "There are tricks in all trades and I heard of one the other day that may apply to your case. You said that Mrs. Martin is off on a visit. You can give her a good surprise when she comes home. I'll tell you all about it."

Ed likes to tease. On his wife's return he decoyed her to the second floor and asked whether on her trip she had seen any house better arranged than this self-made model.

"You did your best, Eddie," replied Mrs. Martin charitably. "But I brought home some antique furniture and to make room for it I would like to store a few of our things in the attic. Now if we only had stairs—"

"Put your hand above your head, Sue," advised the husband. "Take hold of that brass ring hanging from a chain. That's right. You didn't notice it was there. Now pull down."

The bewildered wife obeyed and, to her astonishment, a panel in the ceiling opened and there descended to the floor as complete and perfect a staircase, handrail and all, as anyone could wish. It was noiseless, rigid and strong, yet neat and light; so well balanced that one hand easily operated it.

Mrs. Martin was speechless with



*Courtesy of California Wall-Bed Co.*

delight as she tried out the magical stairs that came from nowhere and subtracted not an inch of room space except in usage. She exclaimed the house was now perfect. Martin put out his chest a little and said modestly he didn't invent the thing.

There are tricks in all trades, he observed, and these disappearing stairs were among the niftiest.

There are many houses that could be improved with folding stairs. The device as manufactured takes a ceiling space



*Courtesy of Fain Manufacturing Co.*  
Five minutes before and five minutes after breakfast this table and its benches fold up into the recesses which are shown and which can be made in any wall. Supports fold flat against the tops

A regular bed, to all intents and purposes, which can be wheeled anywhere on its rubber casters, is at the left, but now look below

In the morning the bed folds up against its head, the foot folds down and the device rolls from living room into a shallow closet

only thirty inches wide and about six feet long. Thus it can be installed in a narrow hall or even a closet. A snug-fitting wood panel covers the apparatus when closed. While stair widths are uniform, lengths vary as needed for different heights of ceiling above floor. A carpenter can install the device in a day's work or so.

WHILE the ready-made article looks and acts the best, thanks to its mechanism of wire cables, pulleys and springs along with its hardwood joinery, I have seen a homemade layout that serves the purpose. In this case the wide heavy flight of stairs, pivoted at the top, is counterbalanced with suitable iron weights attached to pulley ropes in the attic.

The reduction in size of dwellings has stimulated development of all kinds of space saving furniture and equipment. The folding bed existed long ago but in a clumsy and dangerous form that made news items and popular witticisms. Today a perfected type of folding bed is used in many apartments, hotels and small homes, especially bungalows.

The new model, of light yet strong steel tubing, folds upward compactly and occupies a shallow recess in the wall, concealed by a secret panel or by a door of wood or glass. It may be placed in a shallow closet. Instead of heavy counterweights, a coiled spring holds the bed in any position between vertical and horizontal, and there is no danger of "jackknifing." A touch of the hand moves the bed. Instead of rusty hinged joints there are now ball bearings. There are all kinds of minor refinements, including rubber tired wheels and strips of protective felt on metal framework so as not to mar furniture. The total weight of a leading model is given as 160 pounds. There are three main types—wall, pivot and detachable roller beds. In the first two the



A cabinet kitchen, occupying the space of a small closet. Stove, sink and refrigerator in a row. Drain board over refrigerator. Space for food storage and dishes above

beds are permanently attached at one end to a wall, recess or closet interior. The wall type simply hinges out into the room, but in a manner so that the head of the bed is outside the recess. The depth of recess need be no more than eighteen inches, while width and height depend on the size of the bed. A pivot type allows the bed to be swung out completely into the room, at the same time reclosing doors of the closet or recess so that the bed appears to be of the ordinary sort. Here there are two doors, one hinged and the other pivoted. The latter, to which the bed is attached, revolves in a complete circle, so that the opening is closed whether the bed is in concealment or in use. The closet depth required is twenty-six inches.

The detachable roller bed closes to a vertical position and is then easily wheeled about anywhere on its ball-bearing rubber-tired casters. Either a closet or a shallow recess suited to the wall type will house the fold-up movable type. It is easier to wheel the apparatus from room to room where flooring is continuous without door saddles in doorways. There are other reasons besides for the omission of door saddles in new construction and remodeling.

**S**ECRET installation for a fold-up sounds intriguing, and some persons like it for a living room. There is no visible door covering the bed recess and the casual visitor never suspects that a sleeping outfit is tucked behind the paneled or wainscoted wall. It is all a matter of good cabinetwork, a pair of so-called secret hinges which do not show outside and a spring catch operated by an inconspicuous metal button set flush in the woodwork.

All regular bed sizes, single, three-quarter and double, are available in the fold-up models. There are also twin beds that pivot in and out of the same closet space. These require three doors

for the opening, each two feet, six inches by six feet, eight inches, which are standard door sizes. In general the stock sizes of doors may be used with the various types of fold-up beds.

The pivot model may be installed with a convenient access through one door to a dressing room or bath.

There seems to be a progressive evolution of shrinking and telescoping in the modern home. Years ago a daring inventor argued that the dining room, used but once or twice a day, was a wasteful luxury. A breakfast nook or dining alcove should be substituted. The idea became popular. Architects replaced dining rooms with stalls just wide enough for a narrow table and two benches. Now those have been abolished in many homes and a fold-up table with benches that hide within a wall at any convenient point are substituted. The outfit fits into any standard wood frame wall or partition built with four-inch studs. Saw out two or three studs, put a couple of headers across the top of the opening and there is space to install a complete eating layout

for five persons. The exterior may be covered with a secret panel or with French glass doors.

The wall space for one model in closed position is two feet, nine inches wide and four feet, six inches high. When open the width is four feet five inches and the length or distance out from the wall is three feet, four inches. The table top is a couple of feet in width, and it is hinged at the center of the opening. Each of the two benches is hinged to the inner side of a half door and has automatically dropping legs. There is a kitchen model with porcelain top table, making it useful also as a kitchen worktable.

Another fold-up device combines a small china closet with a double-

hinged table and a pair of benches. It is finished in white or gray enamel, also in two coats of flat underpaint so that the final surface may be done to match the house finish.

For those who have a suitable alcove space there is a fold-up table and, instead of benches, four individual seats that fold into the opposite walls, two seats on each side. Here the wall supplies a back rest, which is a grateful feature. With this equipment it is optional to include a folding ironing board. The table dimensions are about two by four feet with a height above floor of thirty inches. The wall case is twenty-six inches wide by thirty-two inches high. Its depth is six and a half inches. The chairs are installed in the walls with slight cutting, since the required depth is under two inches. Attachment to brick or hollow tile is obtained by the use of expansion bolts.

**K**ITCHENS in olden times used to be the size of modern living rooms, and indeed they functioned as such, besides being laundries and places of food storage. They were reduced in size by regular stages. Scientific housekeeping then came along, counted the steps between this and that and brought in a verdict that the kitchen was yet a world too big. Why, the cook rattled around in it like a single player in a baseball park. So the kitchen was made smaller, with a notable relief of backache. The slogan was "no steps, no stooping." Slide-out seats, gas and electric ranges, fireless cookers, an electrical "slavey" unit that performs mechanically a dozen operations like grinding, churning, sharpening and polishing that were formerly done by hand.

We thought the limit was reached. It flabbergasts us now to see the kitchen telescoped to a cabinet that will fit within a moderate sized closet. Everything is included, from stove to ice box, from sink to flour bin and dish closet. The cook can not lose a step or a motion any more than can a mechanic at a Ford assembly plant.

The cabinet in one model varies in width between six and seven feet and has a similar height and a depth of around two feet. A gas stove with oven is on one side, in the middle, a porcelain sink, and at the other side, a drain board or table above an ice box. If desired, an electric refrigerator unit is placed under the sink. There are drawers and shelves for cooking utensils under the stove, while numerous big and little compartments above give space for food, condiments, dishes and whatnot. The sink faucet embodies the useful modern feature of mixing hot and cold water, while the long spout with slightly turned down end is movable so as to avoid interference with utensils and dishes heaped in the sink. The cabinet is built of wood with white enamel finish or otherwise as desired.

A large family might supplement the unit described with another cabinet with more storage space for food and dishes and with the added feature of a broom closet combined with a fold-up ironing board. There are other models of condensed kitchens which include all or part steel construction, with electric stove instead of gas.

Besides the

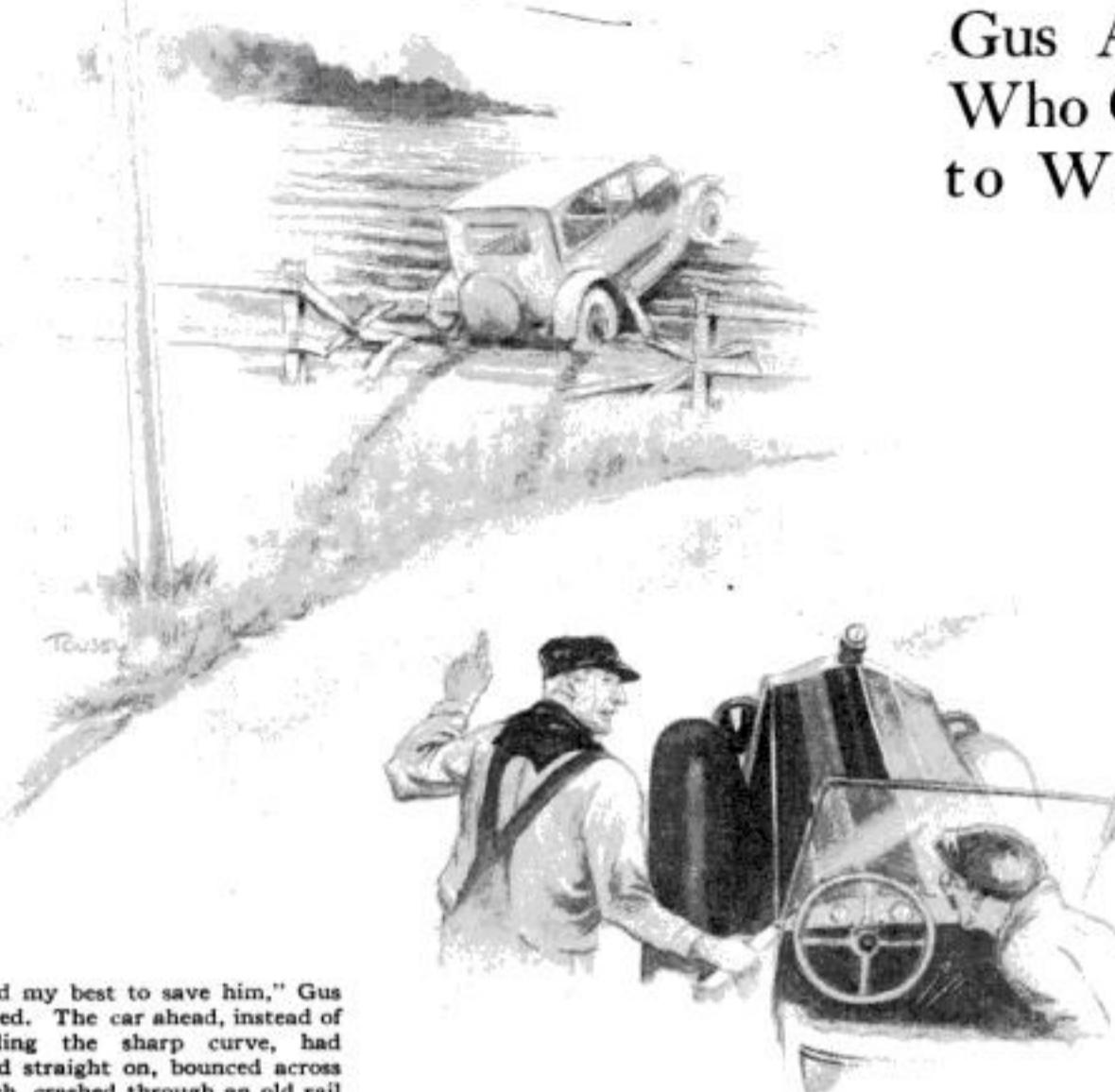
(Continued on page 173)



Courtesy of Bessler Disappearing Stairway Co.

Half of this stairway slides into the attic and the other half fits against the ceiling of the lower room, virtually invisible when not in use

# Driving—Dozing—Death!



"I did my best to save him," Gus shouted. The car ahead, instead of rounding the sharp curve, had rushed straight on, bounced across a ditch, crashed through an old rail fence and stopped in a plowed field.

**B**ILL," said Gus Wilson to the youngster who did odd jobs around the Model Garage, "Joe and I have to go down to the bank this morning. If anybody wants any repair work done tell 'em we'll be back in an hour.

"Come on, Joe, let's go," the veteran auto mechanic called to his partner as he climbed into his car and stepped on the starter pedal.

It was still quite early and only one car was in sight, far ahead, down the smooth concrete road.

"Gee!" exclaimed Joe. "What a swell day this is! Always plenty of pep in the air this time of year. Show me what the old bus can do!"

"Just spoiling for trouble, aren't you," growled Gus with a twinkle in his eye. "All right. Here goes—hold on to your hat!"

He slouched down in his seat and took a firm, two-fisted grip on the steering wheel. The motor suddenly broke out in a staccato, singing roar and the wind began to whistle past their ears. The car ahead was squarely in the middle of the road, which, while smooth enough, was none too wide. But the driver refused to pull over so Gus had to take his foot off the accelerator.

"That duck must be deaf," snorted Joe. "Or maybe he's just one of those confounded road hogs. That's right, keep tooting at him," he shouted as Gus suddenly sat up straight with his gaze intent on the driver ahead and working the horn as if his life depended on it.

## Gus Aids Napping Autoist Who Crashed and Tells How to Ward Off Drowsiness

By MARTIN BUNN

driver mumbled trembly as Gus continued examining the car.

"Nothing important is damaged as far as I can see," Gus announced at length. "Of course your headlights are smashed up but I think the running gear is all right. I'll see if I can get it back on the road."

He pressed the starter pedal and the motor responded at once. Throwing it into reverse he let in the clutch very gently and the car slowly started backward. As the front wheels climbed a ridge left by the plow, there was a sharp snap and the front of the car, on the driver's side, sagged.

"**T**HAT last bump must have been the straw that broke the camel's back," observed Gus as he climbed out and went around to the front of the car. "Your luck is still with you, though; the spring is broken off behind the axle pad, so it won't be much trouble to brace it up. We'll jack up the frame far enough to lash a couple of pieces of that broken fence rail in between the axle and the frame. Then you can drive it back to the Model Garage. I think we've got a spring in stock that will fit."

"Why should it be any easier to fix because it's broken back of the axle instead of in front?" the owner inquired.

"The axle is held in line by the front half of the spring," replied Gus, "and if it breaks at that point, there is nothing to keep it from swinging back under the car as far as the shackle at the rear end of the spring will let it. Of course you can lash the axle to the frame fore and aft with rope to keep it in place, but it's a lot more trouble."

"Now," Gus continued after he had propped up the axle, "do you think you can stay awake long enough to drive about a mile up the road to the Model Garage? You'd better take a nap until we can get back and fix up that spring."

"I hate to lose the time," protested the owner, but he agreed, climbed in and drove off.

"How did you know he was asleep?" Joe asked as the garagemen resumed their interrupted trip.

"I didn't know positively," answered Gus, "but it seemed funny that he didn't pay any attention to my horn. Some fellows are always looking for a race and hate to let you pass them, but I knew he wasn't in that class because he didn't speed up and he didn't look around, as he naturally would, to see what kind of a car was coming up behind. And besides his head was so far forward that it looked queer."

"What gets me," observed Joe wonderingly, "is how (Continued on page 137)

"Gosh, it sure was a close shave," the

# Tricks to Improve Your Car

## Piston Groove Cleaner; Tail-Light Guard; Accurate Painting Device; Other New Ideas

GOOD compression in a motor car engine cylinder depends on the fit of the rings in the cylinder and on the fit of the rings in the grooves of the piston. Many amateur auto mechanics fail on a ring-fitting job because they fail to realize the importance of piston ring fit in the cylinder grooves and the need for a clean groove that will permit the

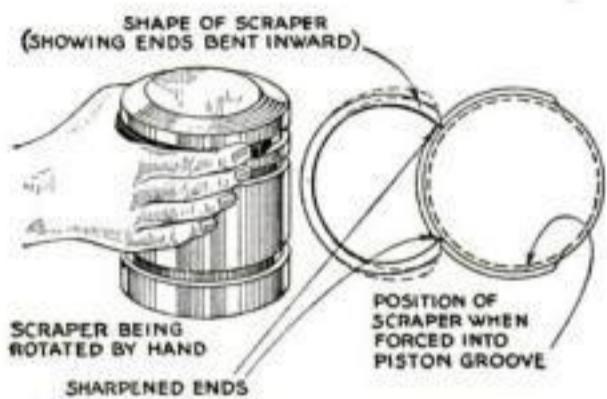


Fig. 1. A carbon scraper fashioned from an old piston ring makes an ideal tool to remove the carbon from the ring grooves in the piston

ring to operate without binding. Before you attempt to fit new rings scrape all carbon and gummed oil out of the piston ring grooves. A simple tool for this job can be made from an old ring. Grind or file off the ends until the remaining portion is about a third of a circle. Sharpen the edges as shown in Fig. 1 and you have a tool to remove the carbon with ease.

### Dash Indicator Lights

INDICATOR lights fitted on your dash will tell you whether your tail and stop lights are properly burning. The wiring diagram of Fig. 2 shows how to fit and wire the indicator lights.

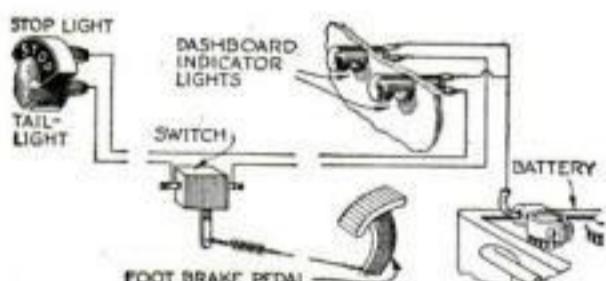


Fig. 2. Indicator lights on your dash board wired as shown may save you from being arrested and fined for not having tail-light lit

You can use ordinary dash lights of the type sold for automobile use, or you can get a pair of the jeweled indicator lights sold for radio use. The latter, fitted with jewels of the same color as the lights they indicate, will make a neat and attractive installation. The theory, of course, is that the indicator light is in series with the light it indicates and when either of the two bulbs in such a circuit burns out, the remaining goes out as well. Instead of 6-8-volt bulbs use 3½-volt bulbs.

### Ten Dollars for an Idea!

C. A. Tubby, of Elizabeth, N. J., wins this month's prize of \$10 with his suggestion of a motor car painting device (Fig. 3). POPULAR SCIENCE MONTHLY awards \$10 each month, in addition to regular space rates, for the best idea for motorists. Other published contributions will be paid for at usual rates.



Fig. 3. Amateur auto painters will find this ingenious homemade device a great help in adding a stripe to the finished paint job

### Ingenious Auto Striper

A SIMPLE aid for striping a car can be constructed from a block of wood, a wood screw and a clothespin. Fig. 3 shows the device in use. The pin is screwed to the block of wood. By turning the pin and moving the brush in the fork of the pin the location of the stripe with reference to the bead on the panel can be adjusted. The block is slid along the panel with the bead as guide.



Fig. 5. Bucking tractors can be cured by fitting an automatic cutout switch that will break the ignition circuit when the front of the tractor raises itself up off the ground

### Extra Curtain Adds Comfort

BY FITTING a curtain around the back of the front seat of the open touring car—with the method illustrated in Fig. 4—you can make the driver as comfortable as he would be in a runabout without at the same time closing in the whole car with the complete set of curtains. It will help to prevent drafts on the back of your neck and will to some extent reduce the force of the wind blowing on the passengers in the back seat, a service for which they will be grateful. In most cases, you will find that the special curtain can be fastened at the sides to the regular curtain fasteners provided on the car. Additional fasteners can be attached to the back of the seat and the top to hold the curtain at these points.

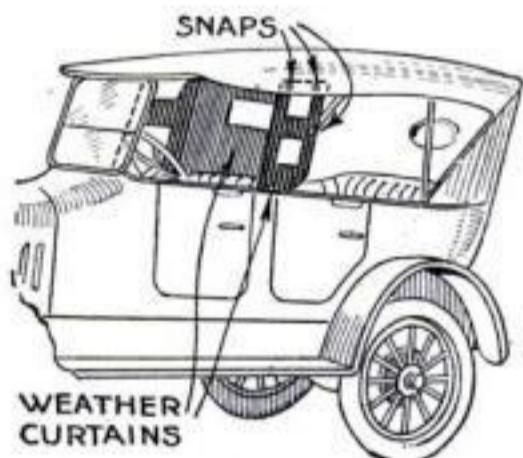
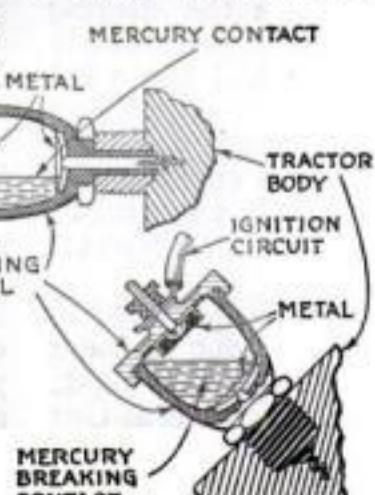


Fig. 4. A special curtain around the back of the front seat in the touring car will add greatly to the comfort of driver and riders

### Curbing Unruly Tractors

THE small farm tractor that drives through cleated rear wheels has one bad habit. When an attempt is made to pull a load so heavy that it is near the limit of the pulling power, there is a tendency for the tractor to rear up on its hind wheels and if the driver doesn't remove his foot from the throttle quick enough, the tractor may roll over backwards with serious results. This peculiar trouble can be eliminated by adding an automatic cutout switch as shown in Fig. 5. When the switch is horizontal the mercury completes the circuit between the electrodes, but when the tractor starts to rear up on its hind wheels the mercury flows away from one electrode and cuts off the ignition, thus stopping the engine and eliminating the chance of a serious accident occurring.



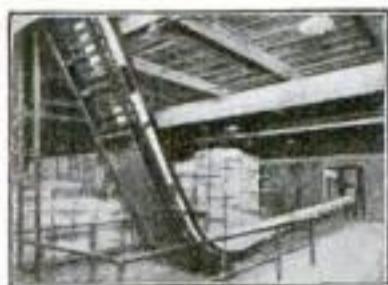


# Telephones and Troops both need behind-the-line support

BACK of the front line soldier there must be a vast machinery of supply. And back of the telephone there is a vast machinery of supply—buying, making, distributing the materials and equipment essential to Bell Telephone service.

To carry out this responsibility Western Electric covers the globe with its purchasing activities, operates the world's largest telephone factory and maintains a nationwide service of distribution from thirty-four telephone supply warehouses.

This work involves buying some 8,000 materials from Asphalt to Zinc, and making some 110,000 separate piece parts for telephones and for all that behind-the-telephone apparatus which constitutes ninety-eight percent of the total equipment.



Backing up the telephone with a reliable service of supply.



Behind the lines at the great Western Electric cable shop.



Some idea of the men behind the machines behind the lines.



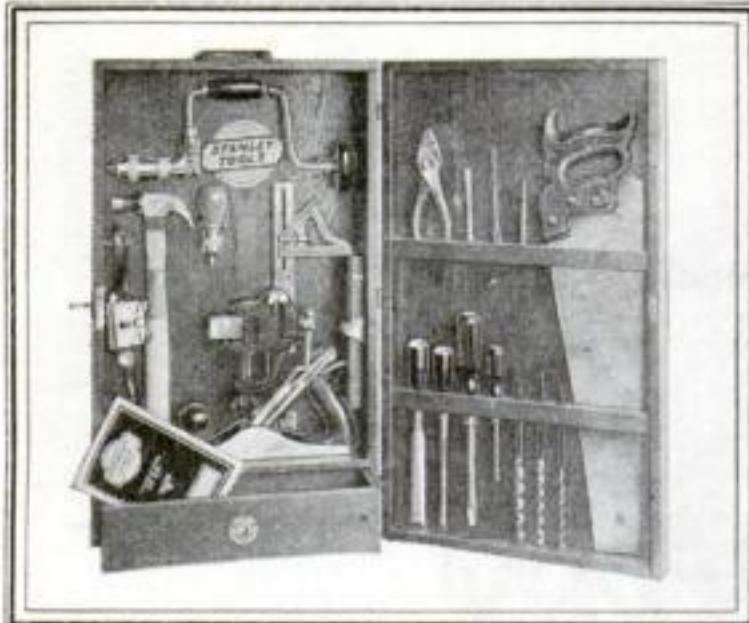
'Way behind the lines—selecting materials from far corners of the earth.



# Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM

Buy separately or in assortments



# If men were cooks!



## Make a Kitchen Cabinet from Plan No. 13e

If men had to get the meals we venture the prediction that kitchen cabinets would quickly become as numerous as front doors! Few Christmas gifts are more welcome than a kitchen cabinet. Stanley Plan No. 13e tells just how to make a cabinet like the one shown above.



Isn't this true?—The better the tools the more pleasure you will get from your work with them. The amateur needs good tools even more than the professional. Most carpenters and manual training instructors use Stanley Tools because they know from first-hand experience that the Stanley name assures durability, correct design, and right "feel."

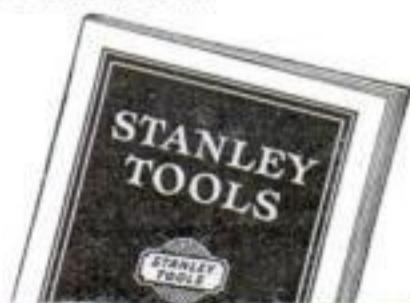
You can buy Stanley Tools separately and so collect your own set. For your convenience in buying there are also complete sets of Stanley Tools in chests at a wide variety of prices from \$15 to \$95. Or there are assortments in strong cardboard boxes containing directions for making your own tool chest. Priced from \$5 to \$20.



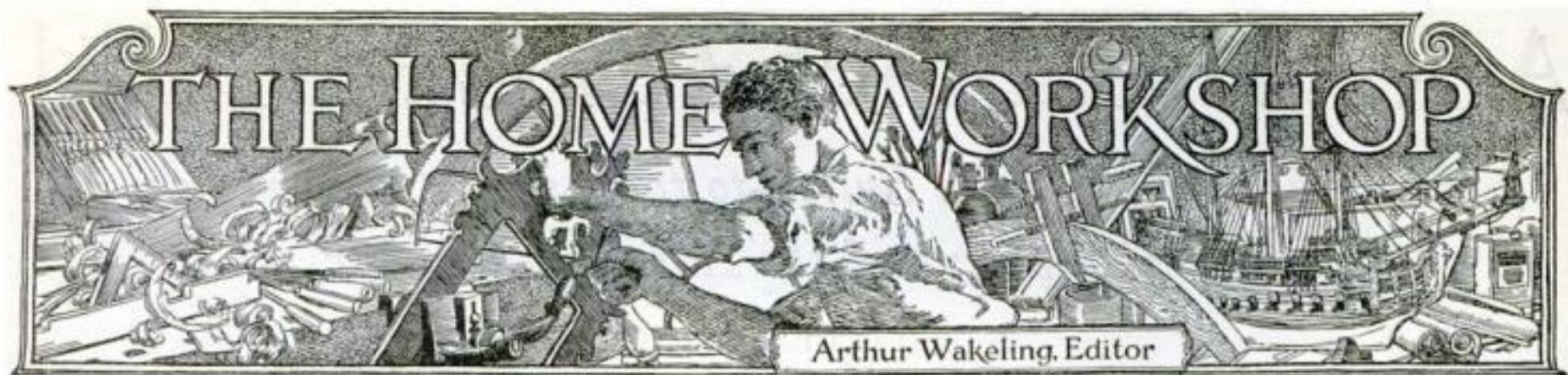
Your hardware dealer has Plan No. 13e as well as other Stanley Plans for making useful articles, or he can get them for you. The plans cost only 10c each. Ask him also for small Catalog No. Se50—which shows many useful Stanley Tools. It is free. If he cannot supply you write to The Stanley Works, New Britain, Conn.

©

The best tools are the cheapest to use  
Ask your hardware dealer



# STANLEY TOOLS



# How to Do Decorative Metal Work

*Benches—Soldering Boxes—Other Equipment*



Large copper lantern designed and made by Mr. Thatcher

as copper and brass. A few good tools, a bench, and a little time to work out ideas for yourself—these are all you need.

I well remember one afternoon when a quiet man came into the classroom and introduced himself as Houdini. I shook hands with him only to find that his hand crumpled up almost to nothing in my moderate grip. Suddenly that wonderful hand of his came to life and my fingers were held in the mightiest viselike grip I ever experienced, yet it did not hurt and a most friendly smile went with it.

Houdini, so he told me, had taken up decorative metal working as a relaxation from the strain of his stage life and he wanted to ask some questions about handling metals. You may be sure that I was happy to be able to tell him what he wished to know. And if he, with all his engagements and traveling, could take enjoyment in this work, how much more we should be able to do so in the leisure of long winter nights at home!

IN EVERY craft there are certain fundamental facts to be learned. The best and only real way to learn them is to do simple things at first, taking up one operation after another. In a surprisingly short time one finds himself able to make things in a way that means something.

For two years I worked with a real blacksmith in his roadside shop and learned more about handling metals than I have before or since. Notwithstanding the fact that a large part of the time I swung

By EDWARD THATCHER

the sledge for the blacksmith while he made horseshoes, I was always learning something. When we were not busy, he would help me with my decorative work.

TRULY, I found that the blacksmith is the father of all metal workers. Many operations are essentially the same in handling iron, silver or gold. The thorough groundwork which I did with that excellent blacksmith stood me in good stead during the many years of teaching which followed, yet no small part of the teaching was concerned with the making of jewelry.

To do successful work with metal one should learn how it is cut, pierced, formed, joined, and decorated. It is my purpose in the series of articles which are to follow to explain these things in detail. While I shall be writing mainly about decorative work, it should be remembered that the various operations described may be

applied to other branches of work, particularly model making.

Surprisingly good results may be had with few simple tools such as a hand drill, hack saw, jeweler's saw, several large files of various cuts and shapes, some small needle files, a good bench vise, a hammer or two, and similar inexpensive tools.

It is often difficult for the amateur craftsman to obtain enough of the right kind of heat for annealing bowls, melting silver or lead, or heating up a large piece evenly for soldering. A medium sized blowtorch for city gas, supplied with a foot bellows, is not too expensive and supplies an ideal way of doing much annealing and soldering. A plumber's gasoline torch may be used by the worker in the country.

A good workbench, well lighted both in the daytime and at night, is most important. It should be as large as space will permit. Indeed, two benches are better, one (Fig. 1, page 119) for the lighter work, which is done seated, and one to hold a heavy vise of the type shown in Fig. 2. At this bench is done the hammer work. The heavy vise is used to hold the different anvils and the stakes, as some of the peculiarly shaped anvils are called. A great deal of both heavy and light work may be done at one small bench, properly fitted up.

IF BOWL and tray making are to be a part of your work, locate the shop in the cellar or outside the house. If you are to do the heavier work and the noise proves to be a problem, here is a suggestion worked out by a friend of mine. He simply set each (Continued on page 119)



Reproduction of a print published in 1576. Many of the tools and methods are practically the same as those used by amateur craftsmen today



Hand-wrought copper lantern by Captain Harry Jenkinson

# A Radio Cabinet You Can Build

*Simplified Construction Suited to the Limited Experience  
and Equipment of the Average Amateur*

By CHARLES A. KING

**A**LTHOUGH it has all the earmarks of fine cabinet-making and would command a high price in any radio store, the console radio cabinet illustrated can be built in the average home workshop without difficulty. That is because the construction has been simplified to suit the limited experience and equipment of the amateur mechanic.

In this respect the appearances of the piece are somewhat deceiving. If you build it, you will find it hard to persuade your friends that it is your work and not the product of a high class furniture factory. It is, therefore, an especially fine project for one who has had little experience in cabinetmaking, yet wishes to make something that can be placed in the living room alongside of fine commercial furniture.

**E**VEN the drawings (see page 90) do not at first glance reveal the simplicity of the construction; the details appear more complicated, especially when shown on such a small scale, than you will find them to be when you do the actual work, step by step. Furthermore, two blueprints, Nos. 70 and 71, have been prepared, which show the construction in great detail. These you can obtain by sending 50 cents to the Blueprint Service Department of POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York. Use the coupon on page 102.

**M**AHOGANY is recommended for the exposed portions and pine for the concealed framework. The inlaid lines are holly. They may, of course, be omitted, but they are relatively easy to apply and add greatly to the value of the cabinet.

Other woods may be used. If white-wood, birch or a similar wood is chosen, use celluloid strips for the inlay, for the reason that they will not be affected by the stain, or omit the inlay entirely. If red



This unusually distinctive console cabinet is 16 $\frac{3}{4}$  in. deep, 36 in. long and 40 in. high. It will hold any receiving set with a panel not larger than 7 by 30 in.

gum is used, it may be inlaid with holly and not stained at all, as it will become beautifully colored with age.

The advantage of mahogany is that it can be darkened by the use of bichromate of potash or lime water, which has little or no effect upon the lighter colored inlay. Inlays set in oak or other open grained woods are apt to be disappointing.

Almost any well stocked lumber yard can supply the materials or obtain them upon short notice. The complete bill of materials appears on Blueprint No. 71.

The end panels may be cut from a piece of  $\frac{1}{4}$ -in. plywood 30 in. wide and 36 in. long. Another piece 36 by 36 in. will allow

the panels for the lower doors, as well as the top, to be cut with minimum waste. The drop door may be either solid wood or  $\frac{3}{4}$ -in. plywood.

The general scheme of construction is shown in the drawing of the partly assembled case on page 90. As the operations are outlined completely on Blueprint No. 71, it is not necessary to describe them in detail here. The following suggestions should be noted:

**D**O NOT put ordinary oil putty in any nail holes until after the stain and one coat of shellac or varnish has been applied, though water putty or special plastic wood fillers may be used at any time.

When inlaying the legs and panels, follow the method shown on Blueprint No. 71. Scrape the inlay flush with the face surfaces and sandpaper thoroughly with No.  $\frac{1}{2}$  sandpaper tightly wrapped around a block.

In permanently assembling the panels and legs use glue, but not so much as to squeeze out and make trouble in cleaning off. Remember that much of the later work depends upon the case's being perfectly square both back and front. Square the back by checking the diagonals and hold with a temporary brace. Then complete the nailing.

Fit 1 $\frac{1}{2}$ -in. brass butts of medium width to the drop door and 1 $\frac{1}{2}$ -in. butts (wide) to bottom doors; also 2-in. butts (wide) to the top or cover. The steps in fitting the hinges are shown on Blueprint No. 71. Fit locks, escutcheons and lid supporters. Make door stops, but do not fasten them until after the radio set is in place.

**M**AKE adapters to suit the set. Either a vertical or slanting face set of any type not more than 30 in. in length and 7 in. in height may be accommodated, although the dimensions of the case may be changed to suit *(Continued on page 90)*

# Five Ways to Paint Tilt-Top Tables

By BERTON ELLIOT

Fig. 1. Oval top with brilliant hand-painted design in modern style

WELL designed and carefully made tilt-top tables may be bought unpainted at relatively low prices in large furniture and department stores, as well as from mail order firms that make a specialty of selling furniture for home decoration. When finished and decorated, they are exceptionally ornamental, which accounts for their present vogue.

The tables vary in respect to the shape of their tops—oval, round, square, octagonal, and irregular—and to a smaller degree in their size and height from the floor. Some have a molded or “pie-crust” edge, others a plain edge. Which design is preferable depends somewhat on the color scheme to be employed and the setting, but it is largely a matter of individual choice.

Many are made from whitewood or poplar, which is sometimes very soft and then does not take lacquer or enamel to the best advantage. Birch is the finest of the woods generally to be found in unpainted tilt-top tables. Given a top of birch, it is not of so much consequence if the pedestal is one of the softer woods.

As in all furniture novelties, the great charm of the tilt-top table lies in its color scheme.

THE oval tilt-top table (Figs. 1 and 3) with molded edge is probably the most popular; it is likewise the simplest to decorate. Two especially good color combinations are as follows: Top in black with gold edge; transfer design of roses (Fig. 3) in rich reds, with deep green foliage; pedestal in black, trimmed with gold on turnings. Top in lettuce green, with molding in gold and a narrow black stripe between the gold and green, which sets off both colors; floral transfer design in medium bright tones, without foliage to conflict with the body color.

A plain top without molding may be given an artistic treatment by painting a stripe of color about  $1\frac{1}{2}$  in. wide around the edge (Fig. 2) and filling in the field inside of the stripe with a contrasting color. Chinese red for the field and a jade green stripe is an effective combination. A peacock or other colorful bird gives the finishing touch. It is more difficult,



Fig. 3. A tilt-top table with a “pie-crust” edge in black and gold. The rose design is a transfer, or decalcomania, as it is often technically called

of course, to paint in the stripe than to follow a molded edge with a trim color. The stripe must be clean cut and true as a die or the effect is crude and amateurish; but those who have had experience in striping or have a friend who can do this part of the work for them, will find the effort well worth while.

A round table top (Fig. 4) is liked by many. When made with a molded edge, it is as easily decorated as the oval top, and the same color schemes may be employed. Care is necessary, however, to select a transfer design of the right shape to look well within a circle. A good color scheme is Chinese red edged with black for the top and either Chinese red trimmed with



Fig. 4. When the wall space is wide, a round-top table is often best

Fig. 2. Table with wide stripe around edge and a colorful bird transfer

black or the reverse for the pedestal. Stippling around the edges is often used for ornamentation instead of or in addition to a transfer design.

A table with square top (Fig. 5) is usually a little larger than other tilt-top tables and is designed especially for use in front of the fireplace. It is generally termed a screen table. A smaller decorative design may be used on a table of this shape when it is to have a fireplace setting. A good color treatment is lettuce green trimmed with gold and a dash of black between gold and green.

STRIKINGLY individual effects may be produced by painting cubist or other fanciful designs on the table top. Black is a good background color for the bright, daring colors this treatment demands. In the design pictured (Fig. 1), pinks, greens and blues are combined in striking array. This treatment is especially stunning when the pedestal is in a different color from the top.

As to the finishing of the table with brushing lacquer, which is generally used, and its decoration with art transfers, the mechanics of the work have been described in detail in recent issues of *POPULAR SCIENCE MONTHLY*. All surfaces, especially the top, must be sandpapered to extreme smoothness, using nothing coarser than No. 4/0 sandpaper. The wood must not only feel smooth to the touch, but on close examination must be seen to be free from tiny scratches. If the table is of poplar or whitewood it should be sandpapered, given a preparatory coat of pure white shellac, and then sandpapered again to extreme smoothness. Three coats of lacquer should be applied on the top without sandpapering between coats; two coats will probably be enough on the pedestal.

It is important that a brush designed especially for use with brushing lacquer be used. A soft hair brush—fitch or bear hair—is best.

Great care should be taken in applying the trim color, so that it will not run over the body color, as it is difficult to clean up spots or smears. Be sure, too, that transfers are perfectly centered, as the least variation will be conspicuous.

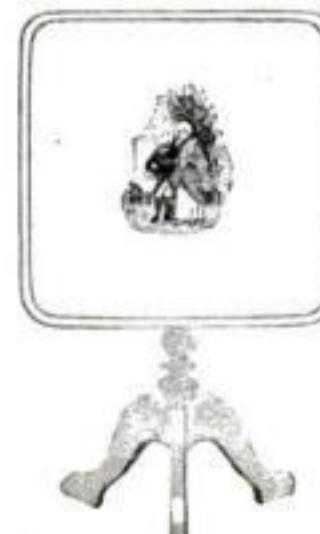


Fig. 5. Square tables are usually a little larger than other types and are intended for use before fireplaces, where they act as screens



# A Simple Power Amplifier

*How to Build a Unit Using a 210 Tube—Supplies All B-Current—No Changes Needed in Set Wiring*

By ALFRED P. LANE

**I**N POPULAR SCIENCE MONTHLY for September detailed instructions were given for construction of B-battery eliminators, one of standard type and the other a de luxe model. Both are capable of operating the largest receivers equipped with the type 171 power amplifier tube in the last stage of audio amplification.

But many radio users want more volume than can be obtained from the 171 tube, and the power amplifier unit shown on this page will give nearly twice as much volume without distortion as can be obtained with any receiver operated on batteries or a B-eliminator that employs the 171 type tube. The tone quality, however, is no better.

The power amplifier unit shown in Figs. 1 and 3 uses the UX 210 type tube as an amplifier with the UX 216B tube acting as rectifier and one UX 874 voltage regulator tube closely controlling the B-voltage available for use in operating the radio receiver.

If you have a receiver of almost any type and wish to use it with the power amplifier unit, the procedure is simple and does not require changing any of the wiring inside your set. First, disconnect and discard the B-batteries you have been using. Remove the tube from the last audio amplifier socket and replace it with the special attaching plug shown at the right end of Fig. 3. The flexible wire from this plug is connected to the binding post marked grid on the power amplifier as shown in the wiring diagram in Fig. 2. The wires that were removed from the B-batteries are connected to the next three binding posts and the loudspeaker cord tips are fastened to the two remaining binding posts. Plugging the drop cord from the power amplifier into the nearest electric light socket and turning on the filament switch on the set puts the whole outfit into operation.

**B**UILDING the power amplifier unit is easy, just as easy, in fact, as building either of the two eliminators described in the September number of POPULAR SCIENCE MONTHLY.

You will need the following parts:

**ABC**—Power unit consisting of a high voltage transformer

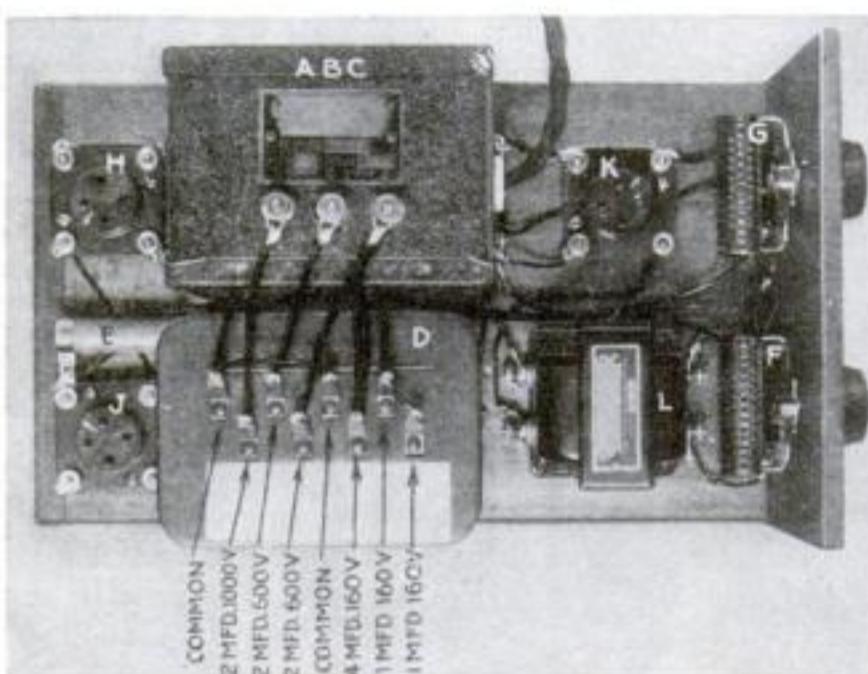


Fig. 1. Follow this arrangement in laying out apparatus. Run continuous wires from point to point so there will be no bare joints to cause short circuits. A larger baseboard may be used to make the wiring easier

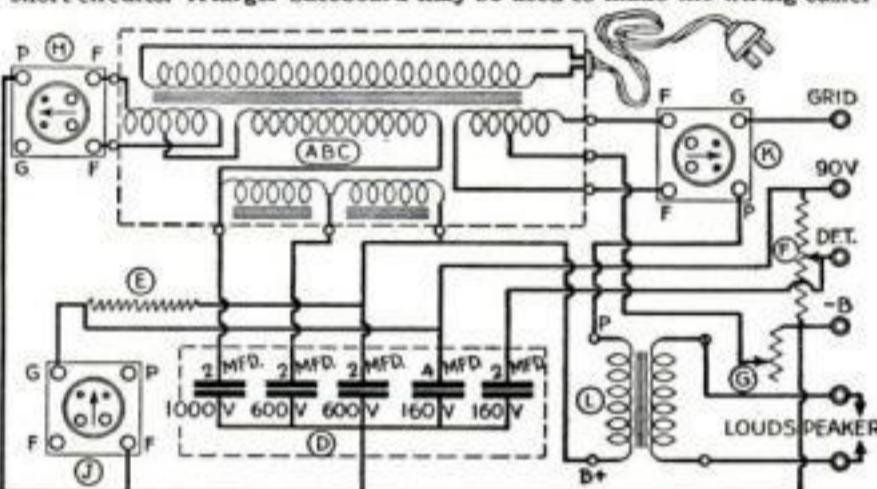


Fig. 2. This semipicture wiring diagram has the terminals of the instruments in approximately the locations as for the actual instruments, except F and G, which are reversed to simplify wiring diagram

capable of delivering 550 volts across the secondary on open circuit with two separate 7½-volt windings and including in the same case two suitable filter choke coils.

**D**—Filter condenser block containing in one case a 2 mfd. 1000 volt unit; two 2 mfd. 600 volt units; a 4 mfd. 160 volt

unit, and a 1 or 2 mfd. 160 volt unit.

**E**—7,500-ohm fixed resistance rated at 25 watts.

**F**—25,000-ohm variable resistance.

**G**—2,000-ohm variable resistance rated at 25 watts.

**L**—output transformer.

**H, J and K**—standard X-type vacuum tube sockets.

Six binding posts, special attachment plug, baseboard and panel.

Use a UX 210 power amplifier tube in socket K, a UX 216B rectifier tube in socket H, and a UX 874 voltage regulator tube in socket J.

**F**IGS. 1 and 2 will show you how to cut the small panel and fit it to the end of the baseboard. Carefully study these illustrations before you start assembling the apparatus on the baseboard and you will find them helpful in determining where to run the wires, using Fig. 2 as a guide for the actual connections. Fig. 2 is a cross between a theoretical drawing and a picture wiring diagram. The internal connections of the power unit and the condenser block are shown, as well as the wires that you are to put in.

You will note that the various pieces of apparatus that make up the circuit are arranged in the same relative positions they have in the illustration of Fig. 1 which was made from a photograph of the model power amplifier unit. The two adjustable resistances, however, have been moved slightly to simplify the wiring diagram.

Remember, in building this power amplifier unit, that you are dealing with high voltages. Over 400 volts are developed in some parts of the circuit and consequently you must be careful with the wiring. Use either rubber covered wire or the special enameled fabric-covered wire that is sold for radio work. No special precautions need be taken to space the wires, but watch out that you do not pull any wire so tightly around a sharp metal edge that trouble will develop later on in the form of a short circuit due to broken down insulation.

Because of these high voltages, which are capable of giving you a severe shock, never in any circumstances attempt to make

(Continued on page 108)

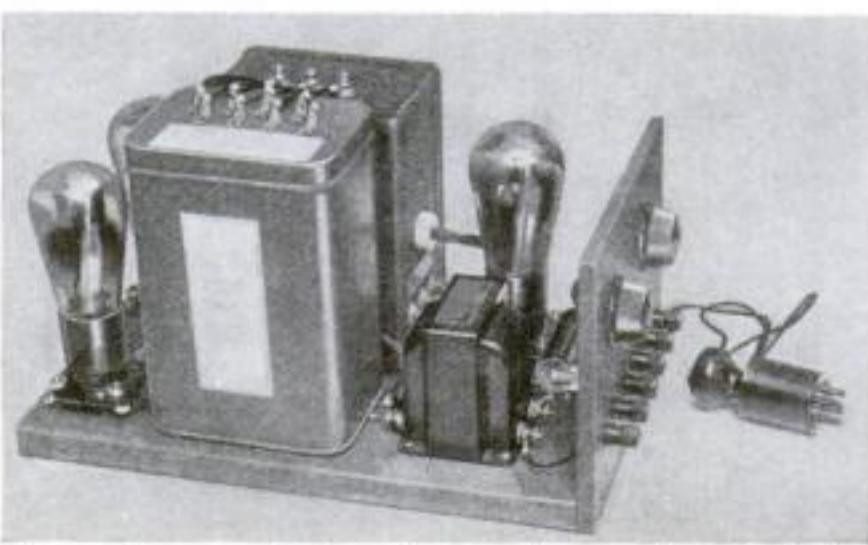


Fig. 3. The nearest knob regulates the detector voltage, the farther one, the C bias. Do not operate this power amplifier unit without the voltage regulator tube in socket J, or the condensers may blow out

# After the game—SORE THROAT



## Gargle when you get home

Suppose your team did win—what comfort is that, a week later when sore throat, or worse, has put you in bed?

Here's a good tip if you will take it. After any long exposure (and that includes cold bleachers) rinse the mouth and gargle with Listerine, the safe antiseptic.

Immediately, it attacks the millions of bacteria waiting for the moment when body resistance is low to strike.

Often, this simple and pleasant

precaution will be the means of sparing you pain and sickness. Listerine nips many a sore throat and cold.

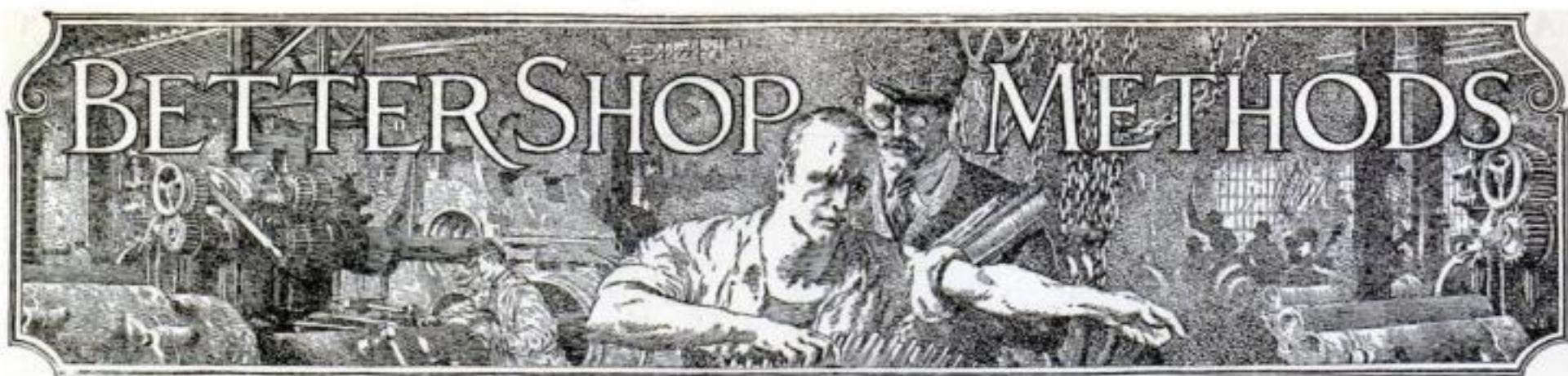
Incidentally, after a football game it relieves that hoarseness which is so troublesome.

The wisest thing to do, of course, during cold weather months is to make a daily night-and-morning habit of using Listerine. Millions do—and are healthier for it. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

SOUNDS LOGICAL  
The great success of  
Listerine Tooth Paste  
has proved that the  
idea of a scientific  
dentifrice at 25¢ (for  
the large tube) is a  
popular one.

# LISTERINE

*—the safe antiseptic*



# Easy Ways to Handle Heavy Work

*How to Save Your Strength and Avoid Accidents When Lifting and Moving Awkward Castings, Tools and Fixtures*

By H. L. WHEELER

EVERY mechanic is familiar with the difficulties of handling heavy, awkward work in small shops where manual methods are in use and even in some of the larger shops on machines that are located away from the cranes.

It is surprising the number of instances when machinists and their helpers have to do heavy lifting. Often two or more men are needed to load and unload machines such as lathes, planers and millers. This is true whenever large castings, heavy jigs and fixtures, and machine accessories such as lathe chucks and face-plates, and dividing heads on milling machines, are in use.

There are men who find this sort of work hard sledding when they happen into a shop inadequately equipped, especially if they have been in the habit of working under different conditions. Generally the rule of such shops seems to be: Get the job done the best way you can with what we have and say nothing. The result is that mechanics are often seen tugging and lugging and straining unnecessarily.

It is no fault of the machinist that shops impose these mule-team methods. However, it is possible for anyone who must contend with adverse conditions to make the work easier and simpler than is customary, judging from the poor methods I have often observed.

DRUDGERY and good mechanics have nothing in common. I believe it profits a man to give all the thought and study possible to making his work easier. By doing so he increases his chances and places himself one step ahead of the procession.

The various devices and suggestions to be described are of low cost and may be economically made "at home." Both from the standpoint of the men and of the shop, they will pay for themselves.

Where heavy castings are daily handled, plenty of tackle, chains, rope slings,

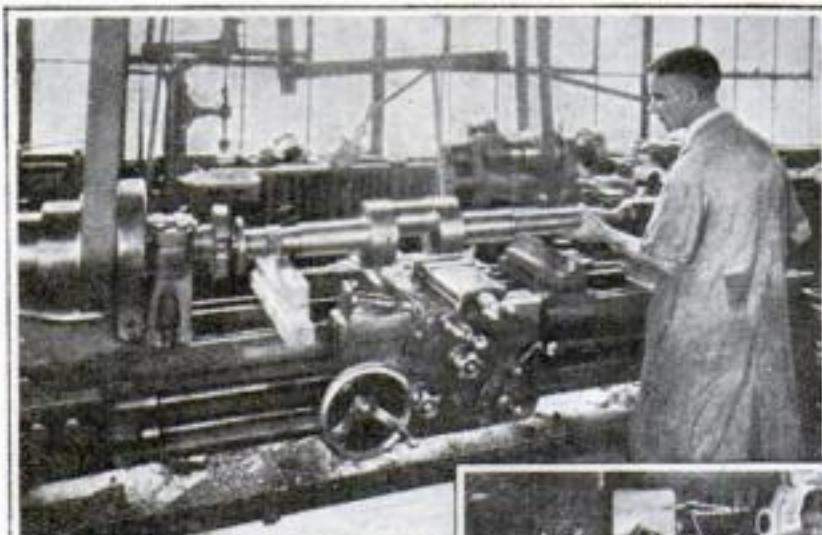


Fig. 1. By a liberal use of blocking one man can handle relatively heavy lathe work

blocking and the like should be available. The large casting shown in Fig. 4 (page 122) is a typical example. There are, of course, many different ways in which such a large casting can be handled. If it were a regular product of the shop, special rigs should be provided for lifting it. For the assembling floor, a circular strap with trunions may be made to clamp around the small outer end for lifting it into place. An emergency method is also shown—a crosspiece of timber, cut the right length and inserted inside the bore under a shoulder.

The circular strap obviously allows the casting to be balanced and guided better when it has to be placed in an assembly or lifted a considerable distance from the floor. If this casting were to be centered in a lathe, in all probability it would have to be turned over. Here again the trunion strap is the more convenient and safer method; it may be left in place until the casting is in the lathe, and there is no interference when it goes up against the

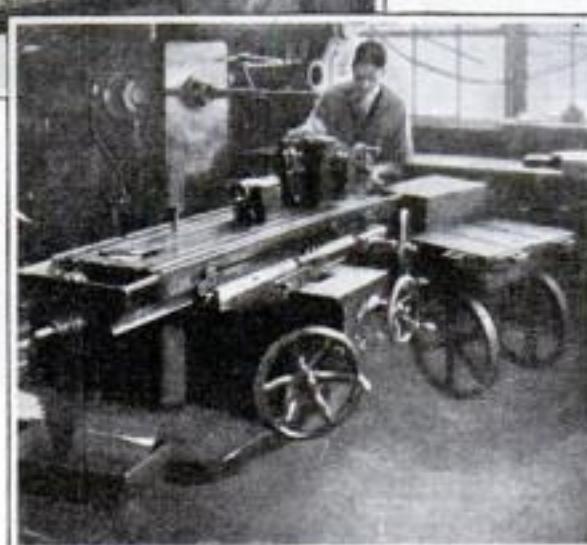


Fig. 2. If a milling-machine dividing head is kept on a truck of the right height, it can be easily slid onto the table without being lifted

chuck as would be the case if a chain or rope sling were used through the bore.

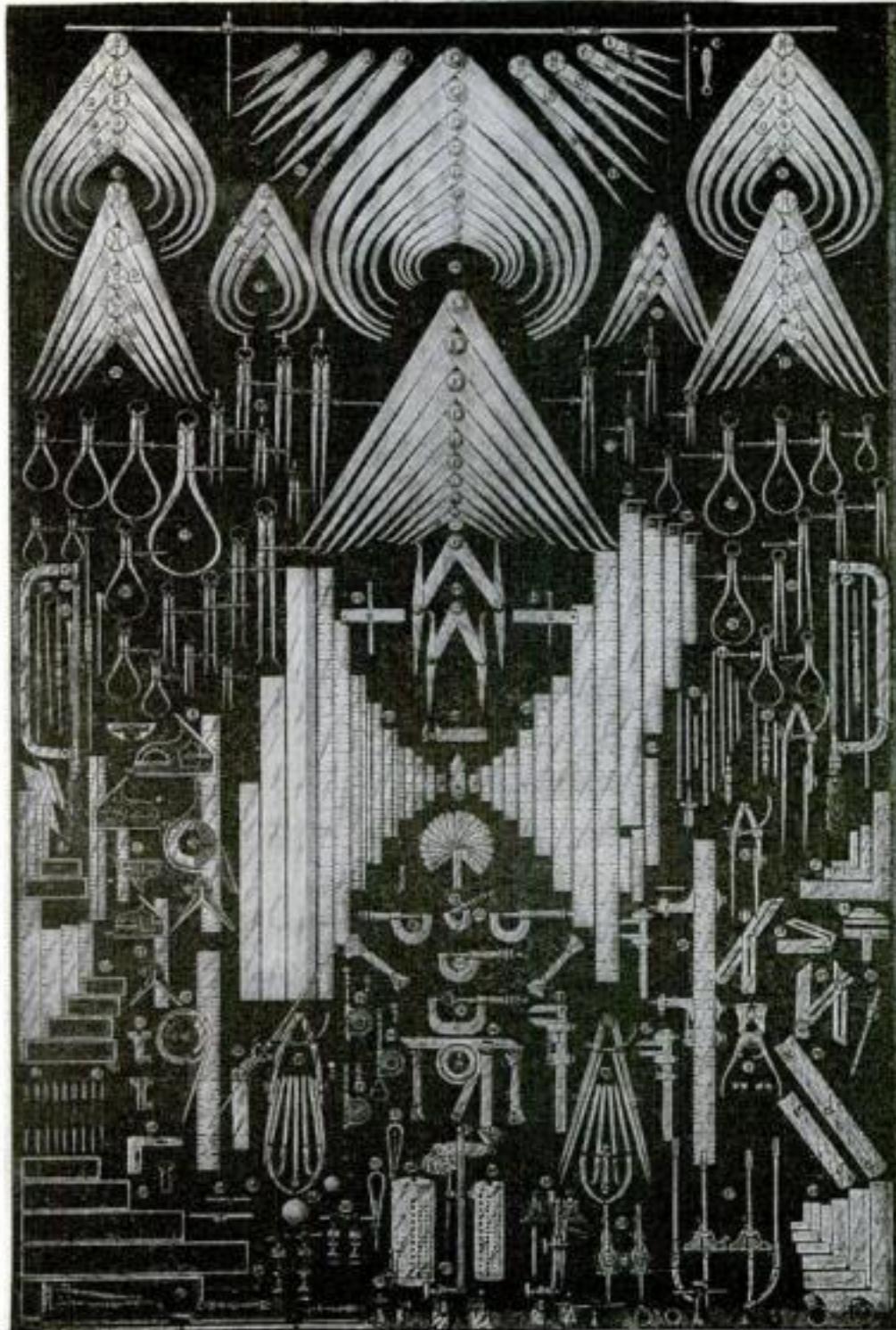
The clevit shown is another useful article to have around the shop for handling heavy work. It affords a safe grip on many large pieces.

All chains, ropes, hooks and other lifting devices should be carefully watched and frequently inspected for weak spots. And they should be tested when there is any doubt about their ability to stand up under a load. I well remember a chain that snapped while four men were loading a heavy machine into a car. They had a very close call and might have been crushed to death. Since then I have been cautious about all equipment used for lifting heavy loads. For this reason I consider it the part of wisdom to pass the word along, even at the cost of what

may appear unnecessary repetition. The strongest part of a chain is the weakest link—an old maxim that every workman should always bear in mind. The loss of life and time through shop accidents is appalling, and every mechanic should do his part to guard vigilantly against mishaps.

How one man can handle long, heavy bar stock or shafting from a pile is shown diagrammatically at the bottom of Fig. 4. With a chain block hung overhead, the bar may be lifted (*Continued on page 121*)

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 112 to 124.



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why Starrett Tools have earned The L. S. Starrett Co. its reputation as the world's greatest toolmakers. Every Starrett Tool sets the standard for quality and accuracy. 

That is why the big Starrett Catalog No. 23 W illustrating and describing the 2500 and more Starrett Tools is considered an indispensable reference by men who appreciate fine tools.

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*World's Greatest Toolmakers  
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Steel Tapes—Standard for Accuracy  
ATHOL, MASS., U. S. A.*

1223



# Use Starrett Tools



## He stropped a new blade and it changed his whole idea about shaving

LIKE many men he had always said "Why should I bother to strop my blades when new blades are so cheap?"

To him a new blade meant a good shave. To be sure the second, third and fourth shaves were not so good, but he got by.

One day on a Pullman he got out a new blade, and was unwrapping it when his friend Putney showed him his Twinplex and offered to strop the new blade.

That first shave with a new blade, Twinplexed, was an eye opener to him. He admitted to Putney that never before had he had such a wonderful shave with a new blade.

Of course he bought a Twinplex when he got home, and now every shave is like that first one,—caressingly smooth.

To his surprise and delight he finds that a blade when stropped regularly on Twinplex holds its original keenness for weeks and weeks. He shaves in less time, has a cleaner shave and has more than saved the cost of his Twinplex.

You can now buy a Twinplex for as little as \$1.50—less than a year's saving on blade purchases. Other models \$3.50 and \$5.00.

### Stropped Blade FREE

Name your razor and we'll send you, free, a new blade Twinplexed. We would like to show you what real shaving is.

TWINPLEX SALES CO.  
1761 Locust St., St. Louis

New York  
Montreal

Chicago  
London



**Twinplex**  
**Stroppers**  
FOR SMOOTHER SHAVES

 This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

# Enter the Stage Carpenter

## How to Build Scenery for Amateur Theatricals—Beginning a New Series

By ANDRE SMITH

Author of "The Scenewright"



When Jerry came to move the set for Act I, he found the frames wouldn't go through the door

NOT so long ago the stage carpenter in an amateur theatrical group was more like a rumor than a fact. At the final curtain, when everybody connected with the show, from the director-in-chief down to the prize-winning ticket seller, stood bowing in the spotlight and received the plaudits of an eager audience, Jerry was not among them. More likely he was cheering in the audience, quite forgetting that he had built the platform upon which the play had been presented, and had given first aid to a few frames which had since vanished behind a layer of canvas. In those days Jerry didn't know that some of the applause to which he was contributing belonged to him.

Today he knows better. When the floral offerings come at the end of a show, although he may not get a bunch of forget-me-nots, he has earned a remembrance. When the next play is put on he won't be forgotten by a long shot.

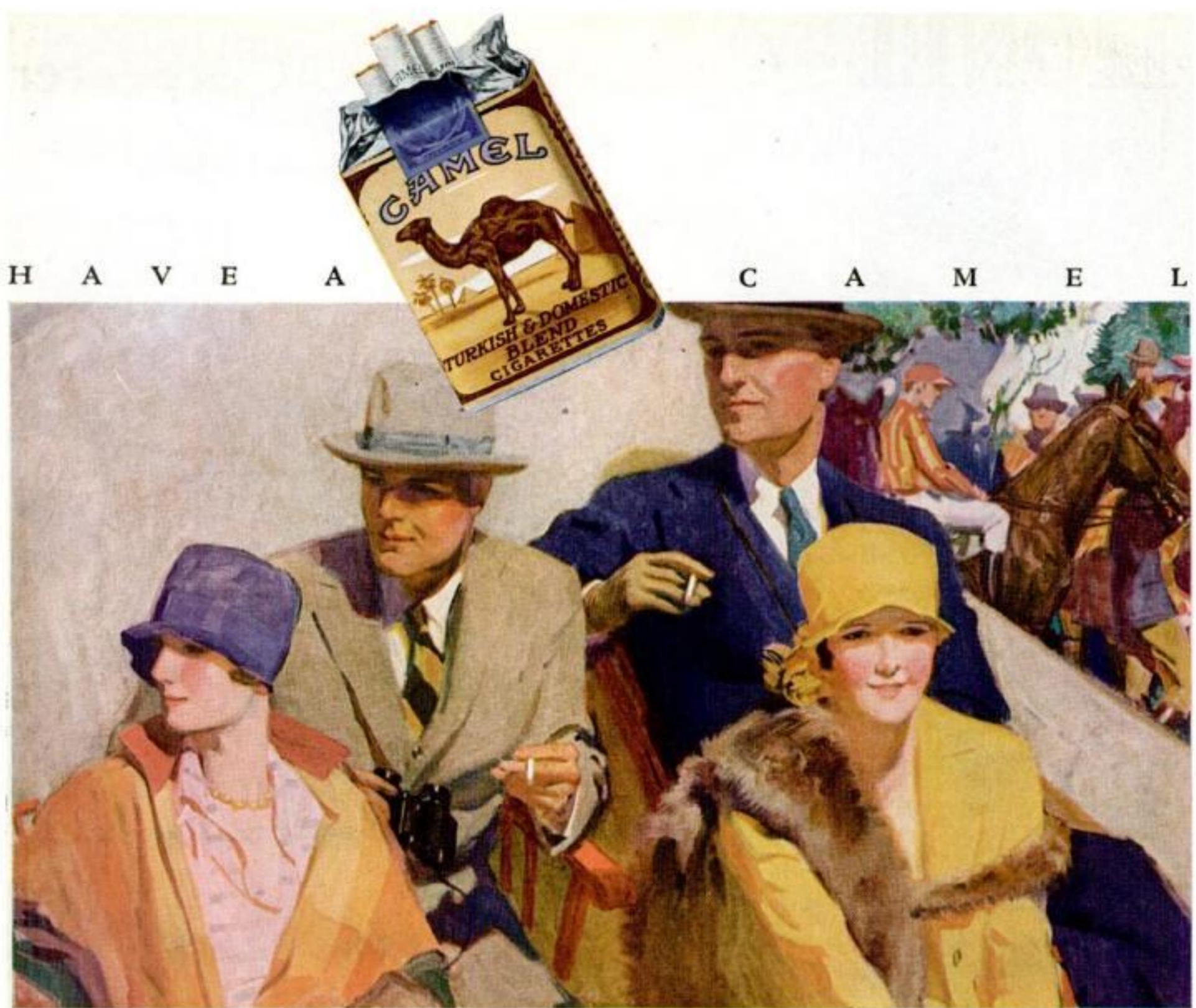
The stage carpenter has come into his own. He is just as necessary to the production of most plays as the actors are. And it is a wise director who will appoint his stage carpenter along with the cast.

You must understand that I am assuming the producing of a play that is not intended for a well organized small-theater group, having its own playhouse and a thoroughly competent working staff, but for a bunch of enthusiasts, one of whom has suddenly yelled, "Let's give a play!" In every live community

someone sooner or later gives out that particular, exciting yell. And after that all you have to do is to find a suitable play, pick the cast . . . and so forth. And it is in among the "and-so-forths" that I would introduce Jerry. And I would make it an early introduction. Because, as I said, Jerry is now far too important to neglect.

AND of the gang I am writing about, who are probably putting on their first play and never suspecting that it will lead them into forming a permanent dramatic club, with four shows a year, big ideas and the dream of a playhouse of their own—of this gang in its enthusiastic infancy, the chances are that the stage carpenter will also be the designer of the settings. Perhaps it will be the other way around: the scene designer will have to build his own sets, convert his designs into actual frames, cover them, and paint them. That is why Jerry plays the highly important part of the handy man who is the life of the party. All he has to do is to design the sets, build them, and then paint them, to say nothing about setting them up and striking them a few dozen times during the rehearsals and the night of the show!

So it is with this talented three-way artist that the wise director will call a conference as soon as he has set the members of the cast to learning their parts. In this *(Continued on page 127)*



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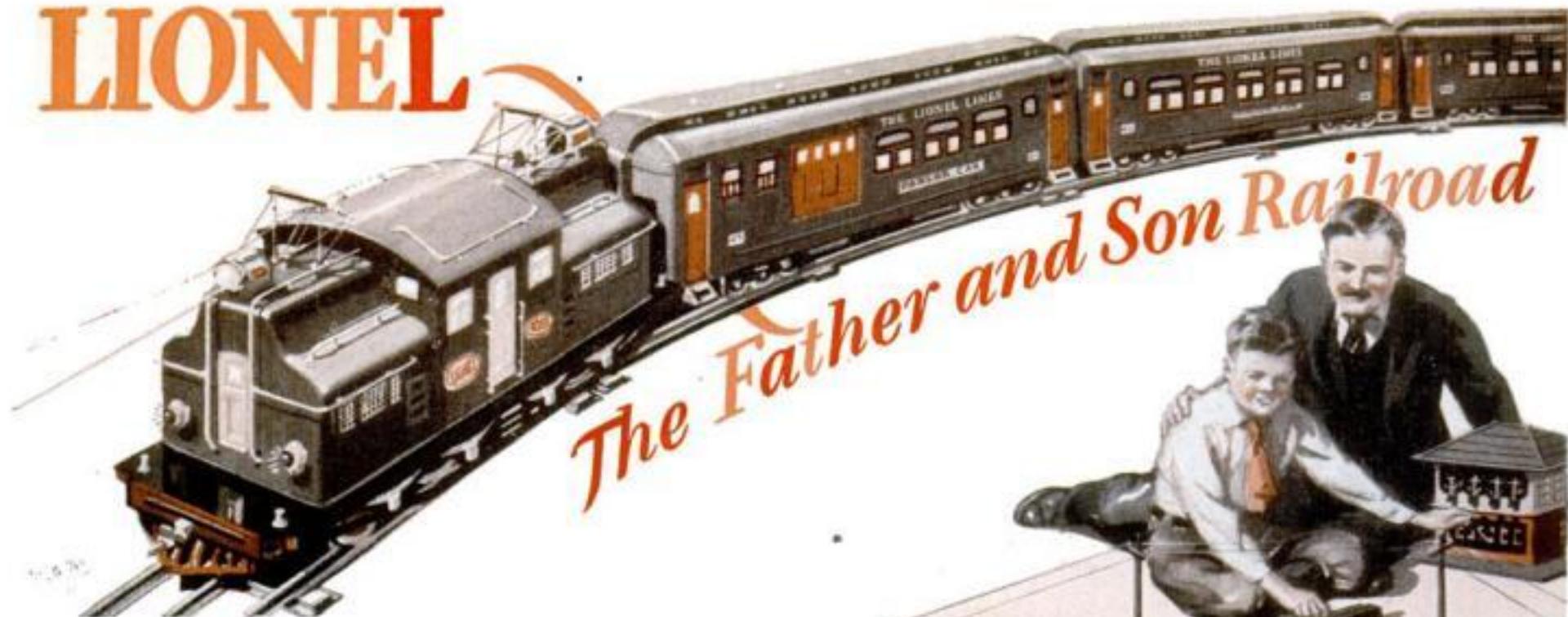
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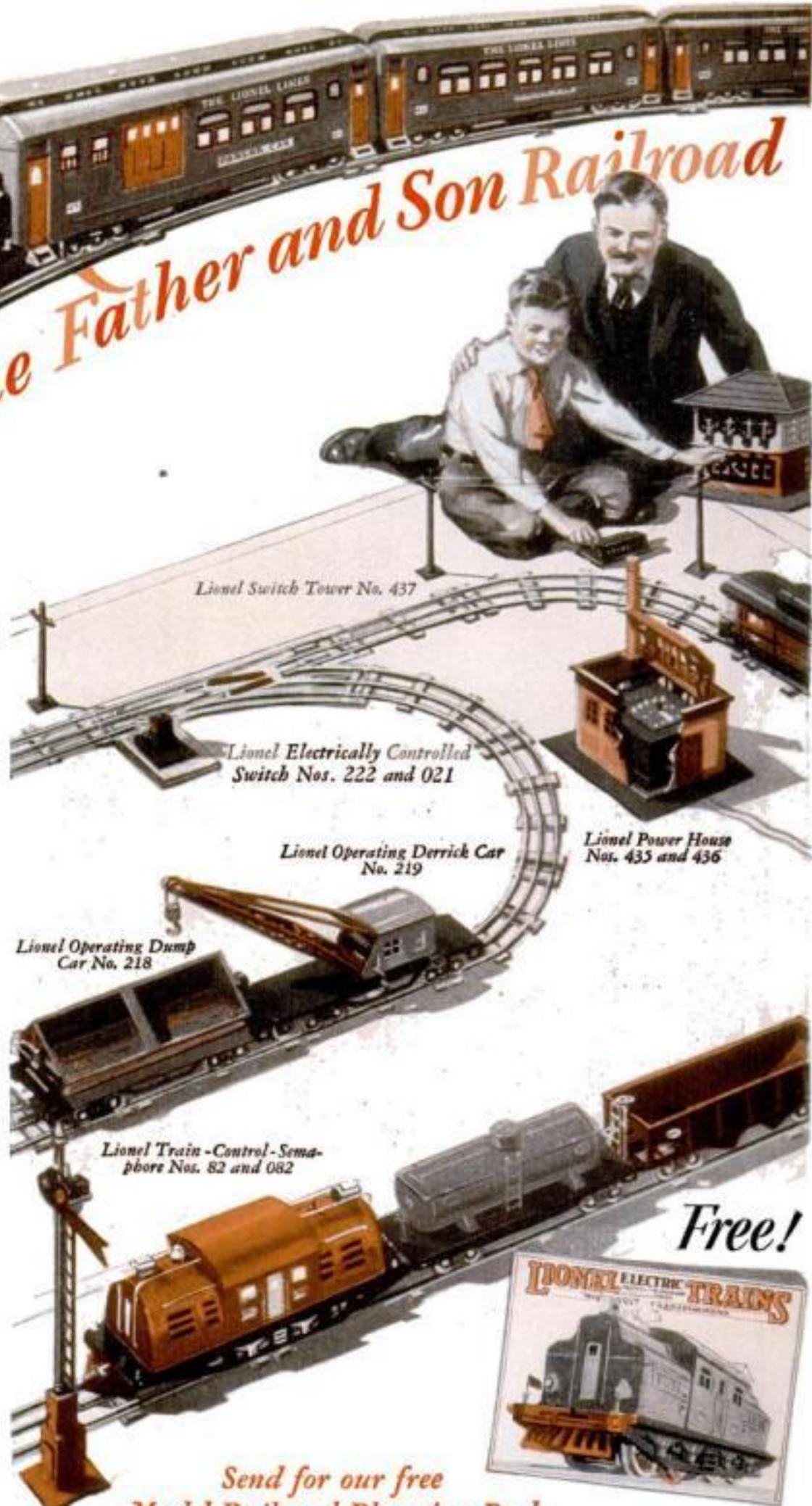
It's marvelous! The crossing bell rings as your Limited speeds by the Station! Look!—there's the Switch ahead. Back in the Switch Tower you touch another lever—the Switch is thrown, the Train glides into a Siding—touch another lever and the Train stops. But—wait! You are building a freight yard down the line. You call to Dad—he couples on the new Lionel Derrick Car with operating boom and tackle, and the new operating Dump Car filled with sand! Again you touch a lever—your Train backs out onto the main line. Throw the Switch again and she's off on her way! Just think! You can do all this at any distance from the track.



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# How to Beautify Your Fireplace

*A Simple Way to Replace an Ordinary Mantel with One of Colonial Design at Surprisingly Small Cost*

By EVERETT EAMES

FOR ages the fireplace has been the most enduring memorial of home life—a haven of comfort and cheer. In our day the main purpose of the fireplace is an aesthetic one, and if it is not beautiful it has little reason for existence. It is not enough that its proportions simply be practical; they should be artistic and make the fireplace the most attractive feature of the room.

Too often the design of the fireplace is left to chance. The result, although it may be a good job of carpentry, is of indifferent appearance. Frequently, of course, the funds available do not warrant the purchase of a well designed and correctly built mantel, but for the man with a home workshop this should be no obstacle. Enough material can be bought for about \$7.50 to build a mantel which would cost \$100 in the finished state.

As the tendency in small house architecture today is more and more toward the Colonial, the mantels to be described will be found particularly appropriate.

The first step, after removing the old woodwork, if any, is to construct a hollow rectangle of the size required by the fireplace opening, allowing a margin the length of one brick on each side and 10 or 12 in. at the top. The horizontal edge should line up with one of the layers of mortar.

THE amount of lumber required depends upon the size of the opening, which may vary from 24 by 30 in. to 32 by 48 in. or even larger; a good average is 28 by 36 in. wide. Of the three large pieces required for the latter size, two should be 9½ by 40 in. and one 13 by 70 in. Whitewood, white pine, basswood, or any other available soft wood that will take paint readily and can be easily worked, may be used. The back should be reinforced and plenty of hot glue and wood screws used as indicated in Fig. 4.

To allow room for suitable moldings and ornamentation, the upper piece should not be less than 13 in. in width and preferably of one piece. Stock this width usually can be obtained in whitewood; in fact, the writer once made the backs of some breakfast nook seats of stock 26 in. wide.

All Colonial mantels have pilasters

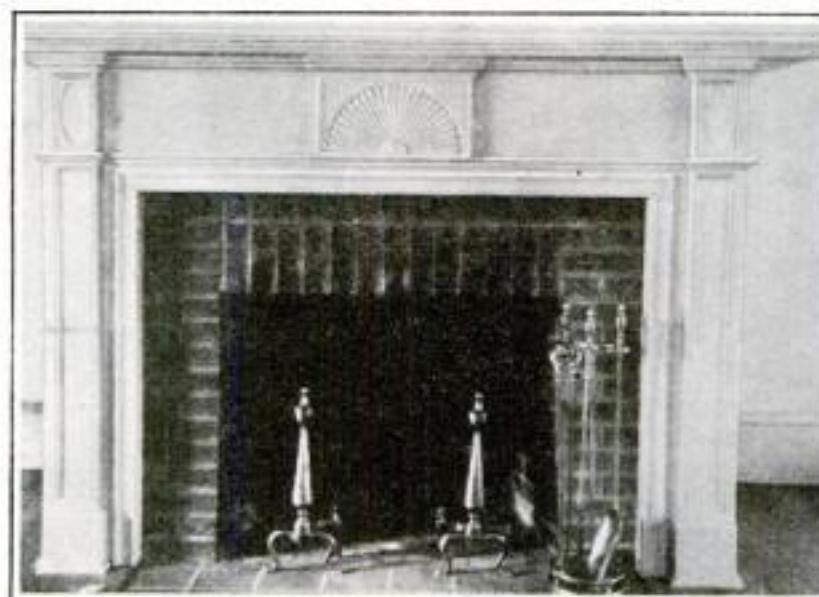


Fig. 1. A Colonial mantel of unusual distinction built by the author at a cost of only \$7.50 for wood and moldings

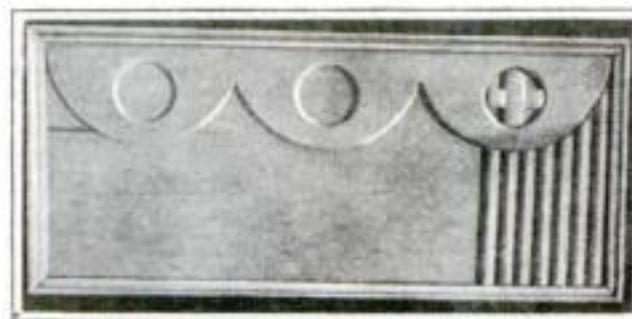


Fig. 2 (above). Uncompleted mantel ornament, showing how the parts are glued on Fig. 3 (at right). One of many variations

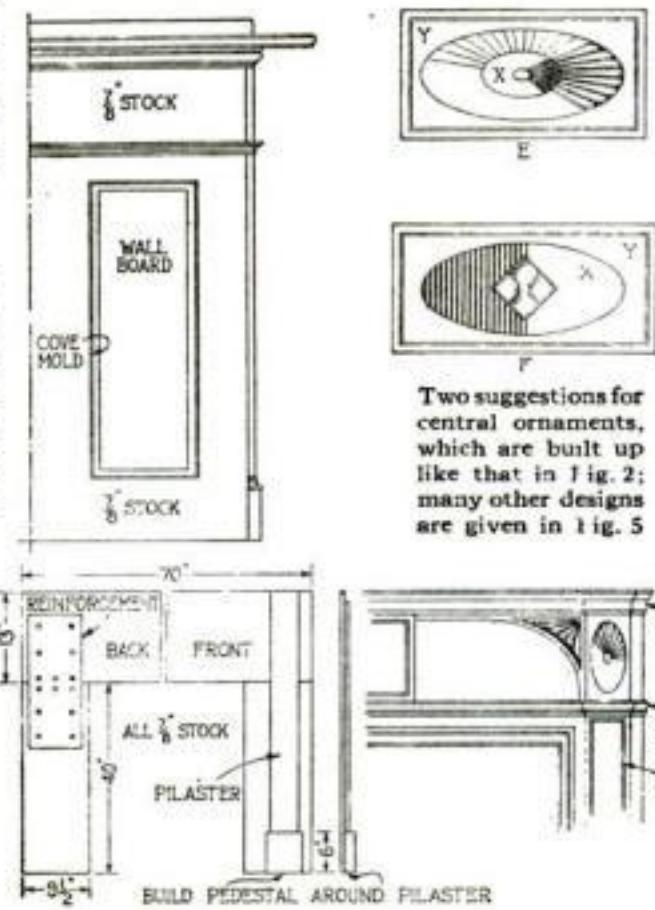
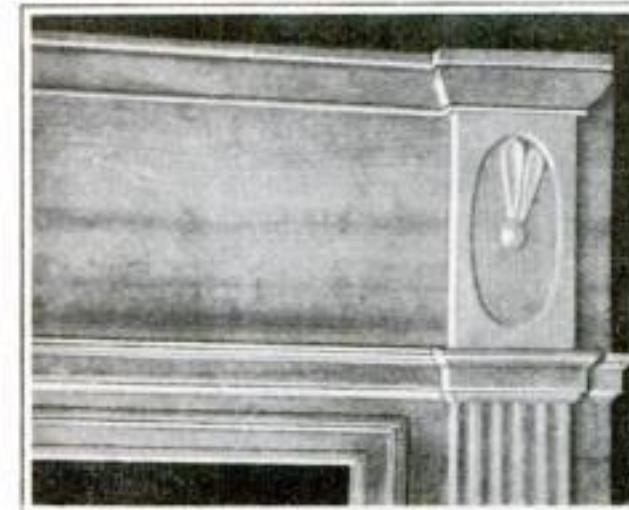


Fig. 4. How foundation work is erected, end view of mantel, and some suggestions for ornamentation

of some form. The base for these is indicated in Fig. 4. It should be glued into position and clamped.

While the glue is hardening, visit a woodworking mill and select a number of moldings. Those used in the construction of the mantel in Fig. 1 are shown in detail in Fig. 5. It is seldom possible to obtain just what is wanted, but the required design can be improvised by planing down one or more corners or surfaces of stock moldings. Those marked Nos. 3 and 4 were obtained in this way, as indicated in cross section. An old wooden molding plane was used to make the flutes in the pilaster, marked No. 7.

The central decoration is what really gives a Colonial mantel its character. The Colonial motifs are carved from one piece, but the home "workshopper" can successfully imitate the carved ones by building up the designs piece by piece.

The design should first be laid out directly on the wood with compass and rule, and lines drawn to indicate the location of each individual piece. Only in this way can an accurately symmetrical design be built up.

JACKKNIFE, plane, file and sandpaper will quickly shape the fan "blades" and sunburst "rays." These "rays" and "blades" should be made about half as thick at the narrow end as at the wide end, which will be either  $\frac{1}{4}$  or  $\frac{5}{16}$  in., depending on the thickness of the upper part of the panel, mentioned later. Basswood is excellent for these small parts as the grain is absolutely straight and never turns the cutting tool from its course.

The easiest motifs to make are those with the vertical half-round pieces worked into the design (Fig. 2; Fig. 4, F, and Fig. 5, C). Each piece should be glued and bradded firmly in position, but it is not necessary to use hot glue as there is no strain on these parts.

The panel upon which the designs are built up consists of two parts, the  $\frac{3}{8}$ -in. base marked X in Figs. 4 and 5 and the  $\frac{1}{4}$  to  $\frac{5}{16}$  in. cut-out part, Y. In making the latter, a fret saw is brought into play to make the long oval or half-round cuts. This piece first should

(Continued on page 82)

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# How to Beautify Your Fireplace

(Continued from page 81)

be attached to the base; the centerpiece, where required, next, and lastly the blades or strips, as the case may be. All brads should be countersunk.

In placing the molding, the cut-and-try method is recommended. The corners must be mitered perfectly. If the miter box has a tendency to play tricks, the file and plane must be resorted to. All of the molding should be glued on, as well as bradded, for the mantel will be heated and cooled and accordingly subjected to many strains.

Enough moldings, center and corner motifs have been shown to make up a dozen designs by putting together various combinations. It is not wise, however, to put on too much decoration.

A coat of thin white shellac should be applied both front and back in order to minimize the absorption of moisture. Leave the top piece of molding loose until ready to set the mantel up. Then drive in a screw wherever a stud can be located through the plaster. The lower end then is toenailed to the floor and a quarter round molding applied as a final finish at the point where the mantel meets the floor.

The shelf is put up last and may be of  $\frac{1}{8}$ -in. stock as the molding marked No. 1 is used around the edge to make it appear of heavier construction. A piece of flooring or other  $2\frac{1}{2}$ -in. or  $2\frac{1}{4}$ -in. strip should be beveled on one corner and used as a finishing strip between the shelf and the wall.

The painting is a part of the interior decorator's job and may safely be left to his discretion. Two coats of enamel un-

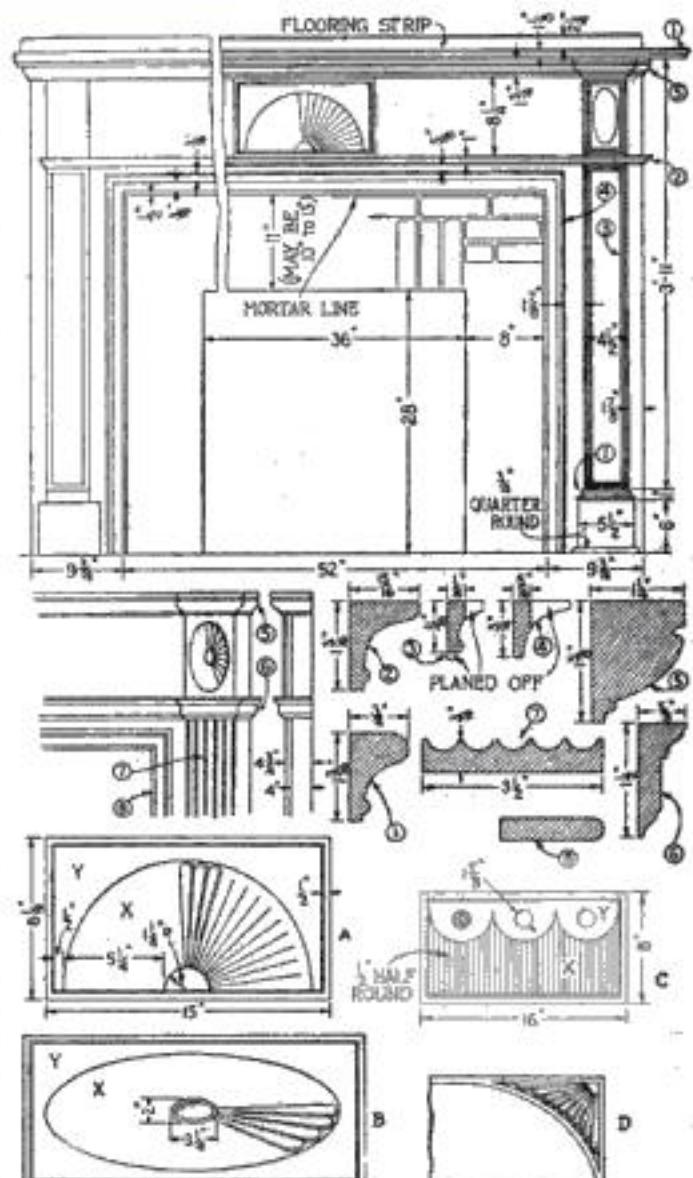


Fig. 5. Working drawings of the mantel shown in Fig. 1, page 81; a key to Fig. 3; other designs

dercoater and at least two coats of the highest grade of enamel are required.

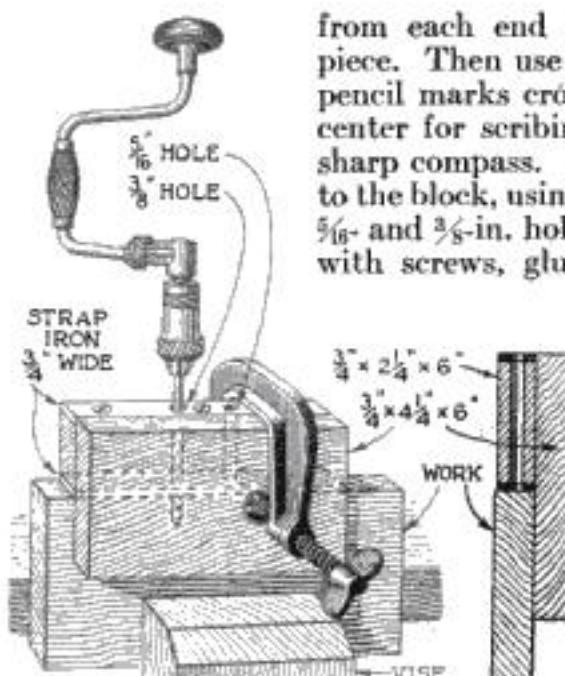
When at last your mantel is finished and you stand off to contemplate your handiwork, you will appreciate better than ever that "A thing of beauty is a joy forever."

## Boring Guide Makes Furniture Building Easier

A DOWELING jig that will enable the novice to bore perfectly true holes to receive dowels on flat work such as table tops and cedar chests, may be made in half an hour.

Cut two 6-in. pieces of  $\frac{3}{4}$ -in. strap iron. Through each drill an accurately centered  $\frac{3}{8}$ -in. hole  $2\frac{1}{2}$  in. from one end, and a  $\frac{5}{16}$ -in. hole an equal distance from the other end. Then drill and countersink three screw holes in each as shown.

Square up a piece of  $\frac{3}{4}$ -in. hardwood stock to  $2\frac{1}{4}$  by 6 in. Gage down the middle of each edge. Locate a point  $2\frac{1}{2}$  in.



How to make and use a simple jig to aid in boring holes for dowels accurately

from each end and square around the piece. Then use each point at which the pencil marks cross the gage marks for a center for scribing a small circle with a sharp compass. Clamp the straps firmly to the block, using the circles to center the  $\frac{5}{16}$ - and  $\frac{3}{8}$ -in. holes. Fasten the straps on with screws, glue the wood to another piece of hardwood, as shown, and drill out the wood between the holes in the straps.

Make a scratch with a small file on the lower strap opposite the center of each hole, so that the jig may be clamped to a board exactly where it is desired to bore. To get a tight fit with factory made dowels, use a steel drill, with lips blunted from a point 2 in. from the end up to the shank.—G. H. WHITEAKER.



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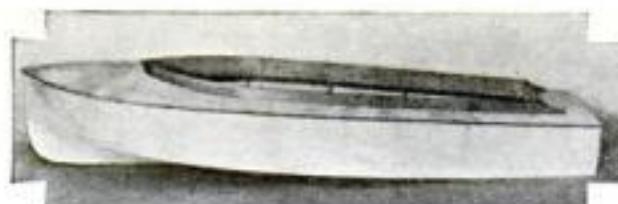
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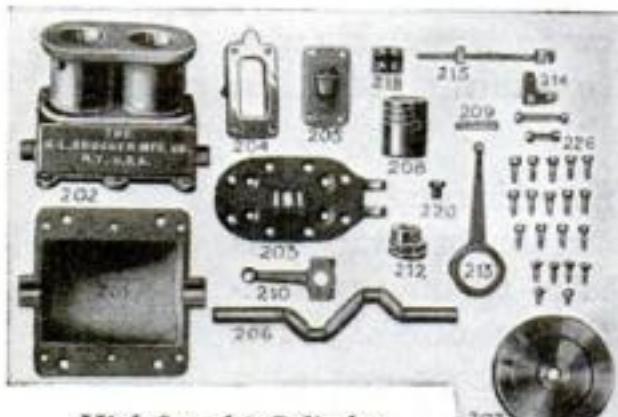
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Stroke	$\frac{3}{4}$ "	Steam pipe	$\frac{1}{4}$ "
Height above base	3 $\frac{3}{4}$ "	Price, ready to run	\$45.00
Flywheel, diam.	2 $\frac{1}{4}$ "	Machined Casting Set	
Width	2 $\frac{3}{4}$ "	Rough Castings	6.00

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# Better Heating at Lower Cost

## How to Install a Labor-Saving Furnace Control System in Your Home

By CHARLES B. CARLON

*In an article in the October issue (page 77), Mr. Carlon told how to install a small, inexpensive blower that would enable you to burn cheap grades of coal satisfactorily in your house heating plant. In the present article he explains various types of thermostatic control systems and gives much information of value on up-to-date, labor-saving methods for regulating heat.*

**T**HREE are a number of methods by which a blower used in connection with a home heating plant may be controlled. They divide in two classes. In one the thermostatic element directly opens and closes the 110-volt circuit; the other mechanically controls a switch. They will be discussed in the order of the degree of automatic control to which they attain. Incidentally, this is about the order of their cost.

Thermostats directly operating the 110-volt blower circuit are of two types, either boiler or living room. Figure 1 shows one of the boiler type installed. A clock for time control may be used or not, as the builder wishes; half the value and convenience of one of these forced draft combustion systems, however, is in having the house warmed automatically, before arising. The cost of the boiler type is about twenty-five dollars. Clock, resistance or switch, and wiring are extra. Boiler control, though, is only relative; the thermostat setting must be varied according to weather conditions. House temperatures will vary widely and are apt to go to extremes.

**T**HE room type 110-volt instrument maintains a more even house temperature, from two degrees below the range set to two above. The cost is about thirty dollars, with wiring extra. All wiring must conform to the Underwriters' Code. Several manufacturers make instruments of the above types and a number of blower manufacturers use them.

The second class of control is the ordinary draft-operating thermostat adapted to move the blower switch by mechanical means. It may, in addition, control the draft doors. The room-temperature range may be adjusted closer

in this type than in either of the others, not varying more than one degree below or above the set temperature. Some blower manufacturers use instruments of this type, but only have a magnetic relay switch and make no provision for controlling the draft doors, thus requiring the use of forced draft entirely. The author has found draft control to be a decided convenience in mild weather and to effect quite a saving as well.

Several manufacturers make instruments of the second class, ranging in price from thirty-five to ninety dollars. The complete outfit consists of a living room thermostat and cellar motor; the former with or without clocks, the latter either gravity, spring or electric.

The principle of operation is much the same in all instru-

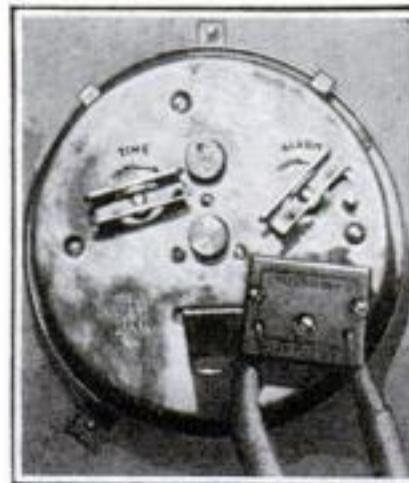
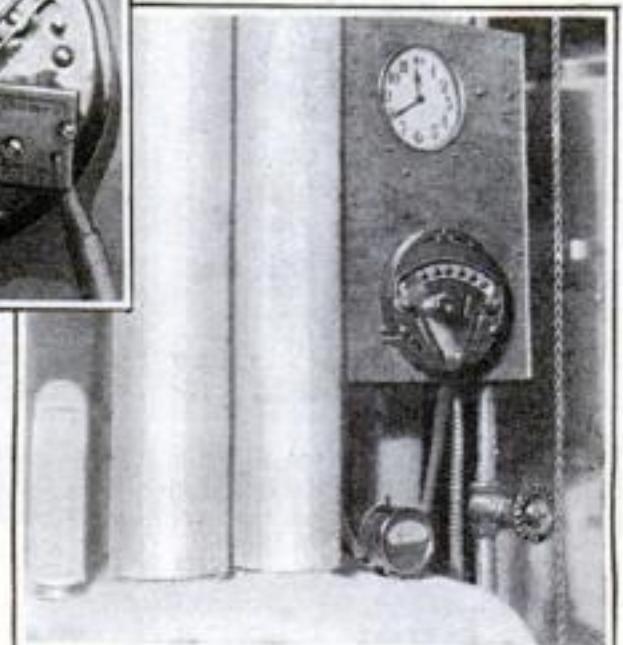


Fig. 1 (at right). Homemade installation to control a heating system. Note the thermostat on top of the boiler. Fig. 2 (above). The back of the alarm clock with toggle switch of miniature type



ments of this type. Variations in house temperature cause expansion or contraction of a bimetal element, closing a battery or transformer circuit when the room temperature falls. This causes the cellar motor to make one half a revolution, pulling the draft chains appropriately. When room temperature reaches normal, the circuit is again completed by the opposite movement of the element, causing another half revolution of the motor and an opposite movement of the draft doors. This cycle is repeated as needed. Refinements and the quality of the clock account for the variation in price. A gravity motor requires daily winding, a spring motor weekly, and an electric no attention. The two former types of motors require two dry cells a year, or a special transformer may be purchased from the manufacturers; the third type contains a transformer.

In mild weather the blower may be disconnected *(Continued on page 129)*

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Throughout the Thirteen Colonies wood built the homes, the churches, the town halls, the schools. Wood built the wharves, the warehouses, the stockades, the barns, the corn cribs, the bridges.

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#### Wood is beautiful

Wood possesses a pleasing natural beauty of grain and texture that mellows and deepens with age and defies imitation. Wood can be fashioned and carved and fitted into thousands of charming designs.

And surely it is significant that the American architect prefers lumber for his own home!

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Of all materials there is none so *friendly*, with such a sense of human companionship as wood. Wood is warm and alive to the touch. The handle of a tool, the steering wheel of your car, the arm of your chair, the bowl of your pipe—you like the feel of them because they are wood.

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Prize Slogan Contest. Please send me free  
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so that I may qualify.

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# Pointers for the Handy Man on Using Wood Screws

By E. E. ERICSON

**W**HAT is there to be said about driving wood screws?" the beginner in woodwork is apt to ask. But the old mechanic and those who have studied the results of recent laboratory tests on the holding qualities of screws, know that a good deal can be said.

In all hard woods, two sizes of bits or drills should be used in boring for screws. The larger one should be from 80 to 90 percent of the diameter of the shank of the screw. After some experience, one can gage the size by placing the drill on the shank of the screw as shown in Fig. 4. With this drill, a hole is bored to the depth of the shank or entirely through the first piece of wood if two pieces are to be held together as in Fig. 1.

A smaller bit or drill matched to the size of the root or core of the threaded part, but no larger, is used to bore to the entire depth of the screw. If this is not done the screw will often break before it is fully driven in place. In soft wood, smaller drills can be used and a hole of the same size throughout is often satisfactory.

When an attempt is made to fasten two pieces of wood together without adequate boring, the joint sometimes cannot be pulled tight because the shank of the screw will not slide in the first or uppermost board. In such a case the only

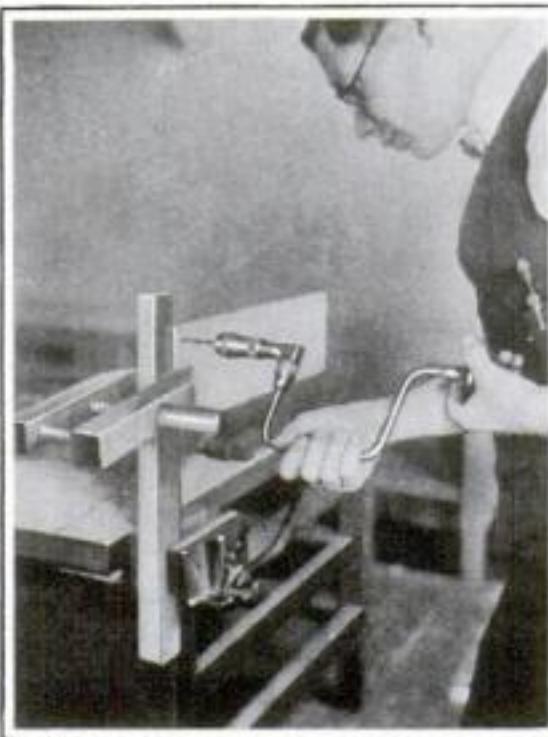


Fig. 1. Of first importance in driving screws is to know what size holes to bore for them

remedy is to remove the screws and bore larger holes for their shanks.

A small amount of lubricant, usually soap, placed on the threads of a screw, will make it easier to drive and help prevent breakage. Tests have proved that the holding power of the screw is not appreciably diminished by this practice.

A countersink should always be used to make a seat for flat-headed screws.

To drive screws a part of the way with a hammer, Fig. 2, is not so vicious a prac-

tice as some would believe, for scientific tests seem to indicate that the holding power of a screw is slightly increased by being so treated, provided it is not driven too far. The blow of the hammer bends the fibers of the wood down-

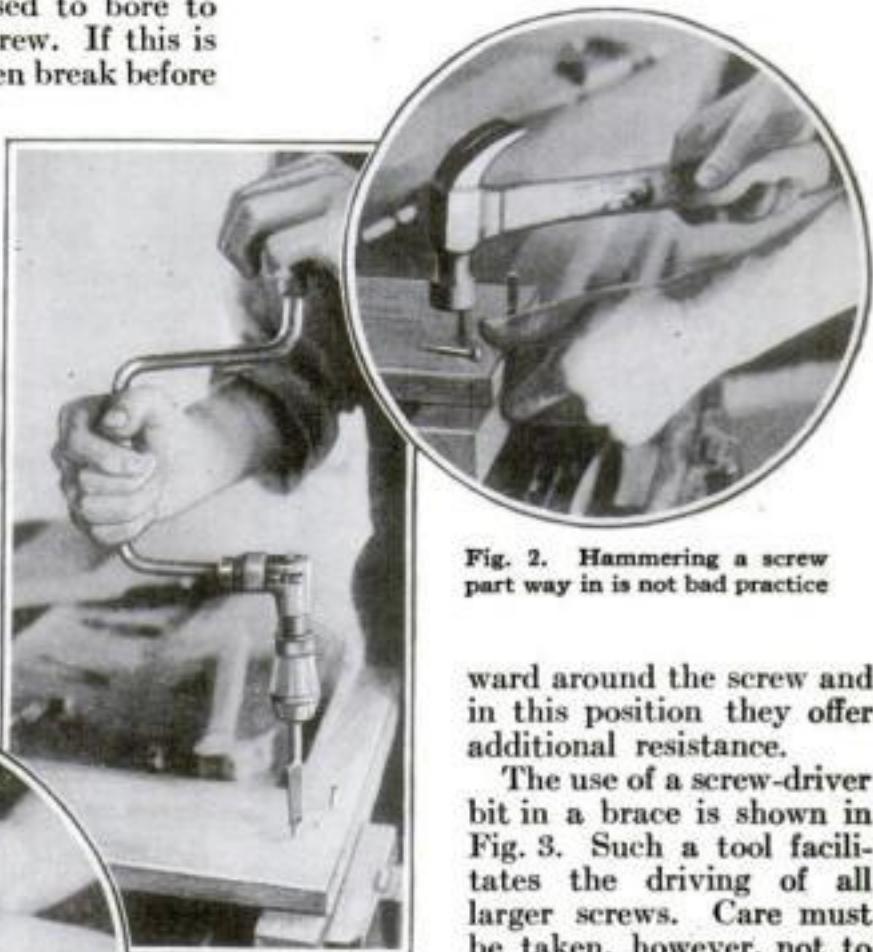


Fig. 2. Hammering a screw part way in is not bad practice

ward around the screw and in this position they offer additional resistance.

The use of a screw-driver bit in a brace is shown in Fig. 3. Such a tool facilitates the driving of all larger screws. Care must be taken, however, not to drive the screws too tight, for the mechanical advantage of the brace is great.

Fig. 3. Driving a screw is easy work with brace and bit

Other things being equal, longer screws have more holding power than shorter and heavier ones. Screws inserted in end grain will not hold more than 75 percent as much as those in the side grain, therefore use longer screws.

Fig. 4. Matching the screw and bit



# INGERSOLL produces a Fountain Pen

## Proved by Impartial Scientific Authority to Differ from Cheap Junk Pens that Hoodwink the Unwary

*Everybody can now afford a reliable  
dependable fountain pen!*

In selecting a Fountain Pen always be sure to go beyond its LOOKS. Remember that all the wear of the pen is on the POINT. You can be easily fooled. Millions are. A common steel pen point costing a penny or two, will outlast the average fountain pen with soft gold point.

INGERSOLL PEN points are made of solid 14-Karat gold, tipped with the finest grade of the hardest metal known to science—HARD IRIDIUM.

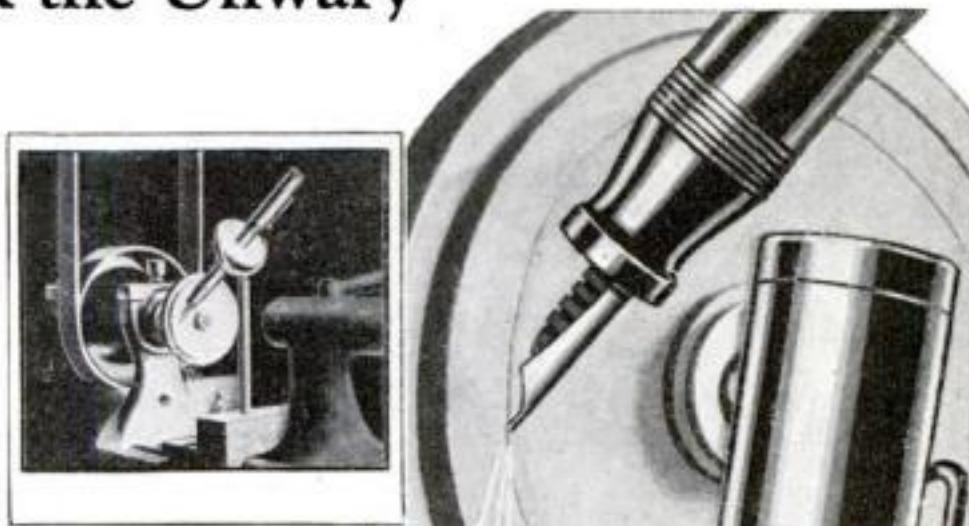
Their everlasting wearing qualities were recently proved beyond the shadow of doubt when ten regular stock INGERSOLL points were taken at random and tested under the direction of the Y. C. LAB by Prof. Louis H. Young, of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Imagine! One by one these ten points were placed against a whirling abrasive stone for a solid hour each! They were scratched over this rough roadbed of flint that wears away the hardest metals for a distance of FIFTEEN MILES—greater than the distance between New York City and Newark, N. J.—without a single one of them losing their smooth writing quality in the least degree!

At the same time, ten steel pen points—admittedly more durable than the ordinary soft points used in cheap fountain pens—were subjected to the same test and rendered totally unfit for use after a few seconds.

Reduced to actual writing life the Y. C. LAB test was even more amazing in that it proved that the wear on the INGERSOLL pen point was equivalent to the writing of the word "the" 144 million times. In other words, to give a pen the same amount of wear in actual writing service, you would have to write 30 words per minute, ten hours a day, every day in the year for 21 years! And at the end of even that time an Ingersoll would still be as good as ever!

CHAS. H. INGERSOLL DOLLAR PEN CO.  
558 North Arlington Ave., East Orange, N. J.



*Ingersoll Iridium-Tipped  
Points show no wear after  
15 miles on grindstone*

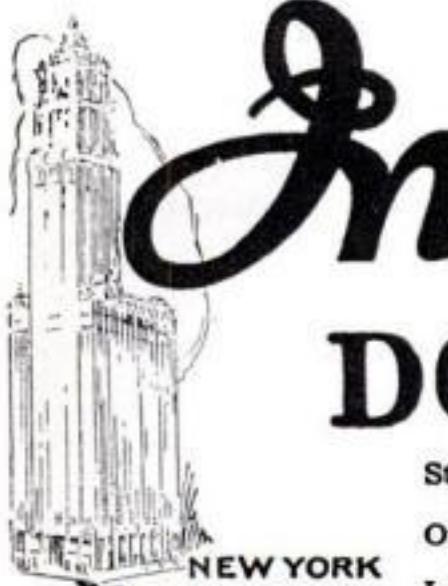
The actual photograph of Ingersoll Pens under test in the Y. C. Lab is reproduced. Each pen was so adjusted that the pressure against the grinding wheels was approximately equal to that exerted by the average writer. Each pen point was also set at a proper distance from the center of the wheel so that the speed of the wheel across the point was 1,300 feet per minute and the total distance travelled in one hour was equal to 15 miles.

Made and Guaranteed  
by CHAS. H. INGERSOLL of Dollar Watch  
Fame. Formerly Half  
Owner and General Manager  
of Robt. H. Ingersoll & Bro.

# Ingersoll DOLLAR PEN

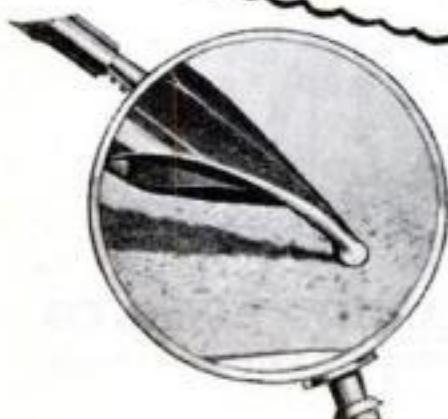
Standard Nickel-Silver Barrel Ingersoll Pens—Men's, Ladies' or Junior Model	\$1.00
Oversize Ingersoll Beauties, Red, Black or Green Durrac Barrels (Model shown)	\$2.00
Ladies' and Junior size Ingersoll Beauties, Red or Black Durrac Barrels	\$1.50

*Sold by dealers everywhere or sent  
direct upon receipt of correct  
price. Specify model and color  
desired when ordering.*



NEW YORK  
CITY

15 MILES

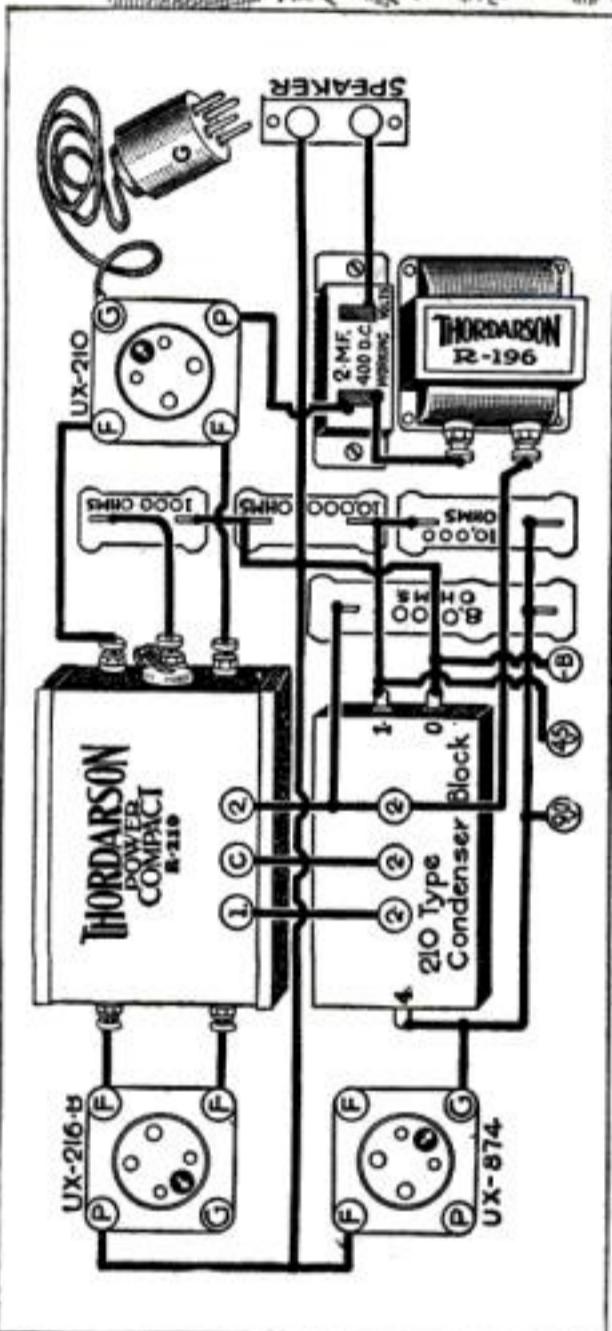


The surface of all writing paper is rough and gritty. It grinds on the point of a pen like a file because it contains some of the same abrasives as a cutting wheel. That is why ordinary cheap pens with soft points quickly wear out even under normal writing conditions.



NEWARK  
NEW JERSEY

# Build Your Own Power Amplifier



*This Booklet is Yours  
for the Asking:*

**POWER AMPLIFICATION SIMPLIFIED**

**THORDARSON ELECTRIC MFG. CO.**  
500 West Huron St., Chicago, Ill.

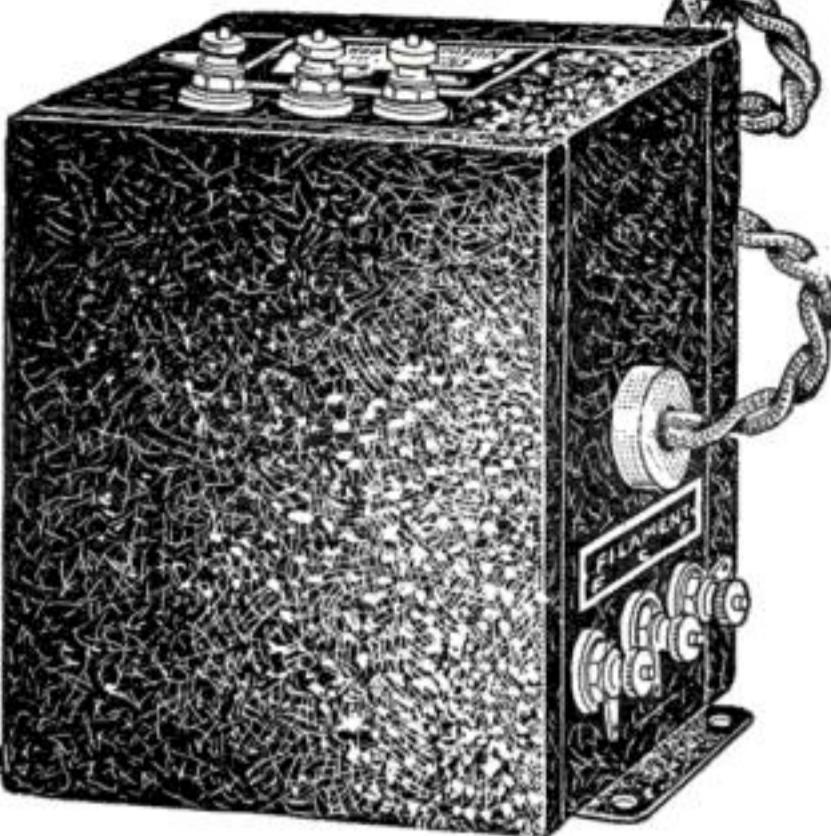
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# *Transform Your Radio Set Into a Real Musical Instrument*

You can build a power amplifier in your own home that will be equal to the finest commercial amplifier and B-supply on the market.

The Thordarson Power Compact is the only complete power supply foundation unit available to the home constructor. It contains the proper rectifier supply, two buffer condensers, two high inductance chokes and the power tube filament supply all in one compound filled case.

The full efficiency in operation and the extreme ease of assembly are responsible for the great popularity of the Power Compact.

No engineering skill is required to assemble the finished amplifier. With a screw driver, a pair of pliers and a soldering iron, you can complete the assembly in from one to two hours.

There are two types of Power compacts. Type R-171 is designed for Raytheon rectifier and UX-171 power tube. Type R-210 is designed for UX-216-B rectifier and UX-210 power tube.

Power Compact R-171 Power Compact R-310

~~Super R171 Tower Compact~~  
~~\$15.00~~ ~~\$30.00~~

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POWER  
COMPACT

**THORDARSON ELECTRIC MANUFACTURING CO.**  
*Transformer specialists since 1893*  
**WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS**  
**Chicago, U.S.A.**

# Paper Hanging Made Easy

Steps to Take in Doing Walls and Borders—Helpful Hints

By  
LAWRENCE B. ROBBINS

**I**N HANGING paper on the walls of a room, begin in a corner. Work from the light towards the dark side of the room so that the lap joints will throw no shadows.

A line should be plumbed on the wall to the right of the corner at a distance of  $\frac{1}{2}$  in. less than the trimmed width of the paper. Use a plumb line—any piece of cord with a weight tied to the end. This will insure the first strip's being straight. In the same manner plumb every third or fourth strip to keep the joints exactly vertical.

Cut a number of strips of the right length and match them as you do so, allowing at least 2 or 3 in. leeway. After you become familiar with the way the pattern is matched, you will find no trouble in making the right allowance and in joining the figure accurately as you hang each strip.

**L**AY the strips face down on the work-bench as explained for ceiling work in last month's issue of POPULAR SCIENCE MONTHLY. Paste the top one preparatory to hanging, fold both ends toward the center, pick up the strip, and mount the ladder until the top of the strip can be unfolded and placed an inch or two below the ceiling. Be sure to get the pattern *right side up*. Lean over and look down along the mark on the wall. Swing the paper so that the edge meets the mark and then press the top of the strip against the wall with your hand or the smoothing brush or whisk broom. Unfold the bottom portion and smooth it down in the same way. Always brush from the outside edge toward the corner and allow the inside edge to turn slightly around in the corner. Brush from the top down. If the strip is found to be slightly out of plumb, lift the paper from the bottom and brush it in place again until it is smooth.



The paper is hung exactly plumb and smoothed with a brush

dull side of the shears, and then use the mark as a guide for cutting. Press the paper back in place and it will be a perfect fit. This is illustrated below.

After two strips of paper are laid, the joints should be rolled. This can be done with any suitable roller. A regular paper hanger's roller is best, but a photo print roller or even a wide bed caster can be utilized. Wait six or eight minutes after hanging the strip before rolling. This will give the paste a chance to set, and it will not be squeezed out

(Continued on  
page 104)



Marking paper where it laps woodwork



The border is applied last of all and covers the edges of both the ceiling and wall strips. It is cut into convenient lengths for handling

Match all following strips and in the corners split the strip before pasting so that the halves will match in the corners.

The trimming can be done with the scissors, as described last month, unless the paper is of the perforated type that allows the margin to be torn off. Note also a reader's suggestion for trimming on page 104.

**W**HEN a strip is to be carried around the woodwork of a doorway or window, it must be cut to fit. This can be done by first measuring and cutting the dry paper, allowing a slight advantage in the size. Then paste, fold and hang. Where the paper laps over the woodwork, scribe a mark by pressing in lightly with the

**New standards of efficiency—New standards of value**

**A**MOST important chapter in the development of oil heat was written a year ago—with the elimination of noise by the new Silent Nokol. So enthusiastic was the public's response to the announcement that the American Nokol Company has been able to write a sequel to this achievement in the form of even greater standards of efficiency, greater values and lower prices.

In their effort to extend the benefits of automatic oil heat to practically every home, the Nokol engineers have specialized during the past year on the smaller sizes—those intended for four, five, six and seven room houses. New refinements, new equipment, new operating efficiency have been added with no increase in price.

Mail the coupon today and learn how easy it is to modernize your home with Nokol automatic oil heat.

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**NEW Silent**  
**NO COAL**  
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REG. U. S. PAT. OFF.  
AUTOMATIC OIL HEATING FOR HOMES

**FREE—NEW BOOK**

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4198 Schubert Ave., Chicago  
Please send me your new book on oil heat.

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Oldest and soundest automatic oil burner manufacturer in the world

# Pipe Smoker Waxes Poetic Over His Favorite Tobacco

Here is a bit of pipe-smoking sentiment pretty well expressed, in our opinion:

## "A Prescription"

Have you ever noticed right after a meal How tired and lazy you always feel? I'm telling you folks it isn't a joke, It will freshen you up if you try a good smoke. But whatever you do these lines you must heed, There's a certain tobacco, of course, that you need. It's packed in a tin, the tin's colored blue. Not only the smoking but the chewing kind too. Of course if you never are bothered this way, Just keep the prescription for some other day. Ask for tobacco, the best that's on earth; To shorten the story, just call it "Edgeworth."

Chas. J. Butler  
Owensboro, Ky.  
Feb. 2, 1927.

To those who have never tried Edgeworth we make this offer:

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to Larus & Brother Company, 10

S. 21st Street, Richmond, Va.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

**To Retail Tobacco Merchants:** If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

On your radio—tune in on WRVA, Richmond, Va. The Edgeworth Station. Wave length (254.1 meters) 1180 Kilocycles.



# A Radio Cabinet You Can Build

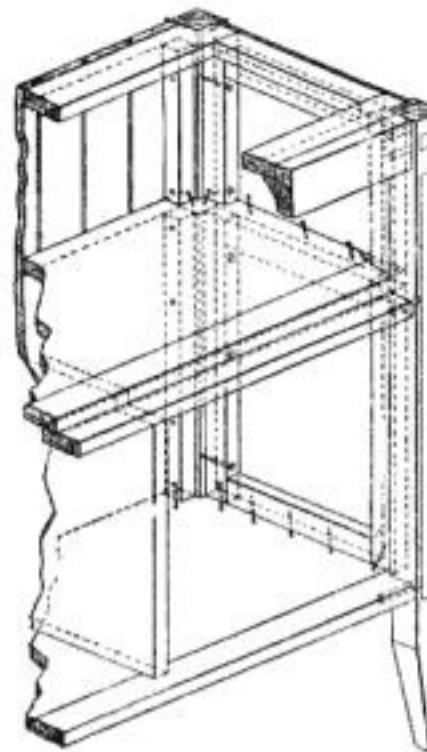
(Continued from page 74)

any set desired without altering the method of construction. Cut lead linings for the battery compartment, if they are desired, and fasten in place with  $\frac{1}{2}$ -in. tinned nails.

The case should be gone over with No.  $\frac{1}{2}$  sandpaper. Remove the doors and hinges. Give the entire outside of the case a light sponge bath of clean water. After it has thoroughly dried, sandpaper with No. 00 sandpaper *without* a block to remove the slight roughness of the raised grain. The wood is then ready for staining, filling and finishing with varnish, clear brushing lacquer or shellac and wax as preferred.

If it is desired to reduce the case to its lowest terms, the inlay may be omitted, the special moldings may be dispensed with or selected from stock designs if the desired wood can be found, and the top may be made of solid wood resting directly upon the top of the case itself. The front and two ends of the top may be molded at the mill, which will do away with the work of making the moldings and mitering them. The curves may be sawed at the mill or may be reduced to simpler forms.

If the case is built of whitewood or birch, either of which may be finished to resemble mahogany with good results, the shelves may be made full width without edge strips. The hinges may be of



How the case is assembled. The end frames are screwed to the legs and no difficult joints are used anywhere

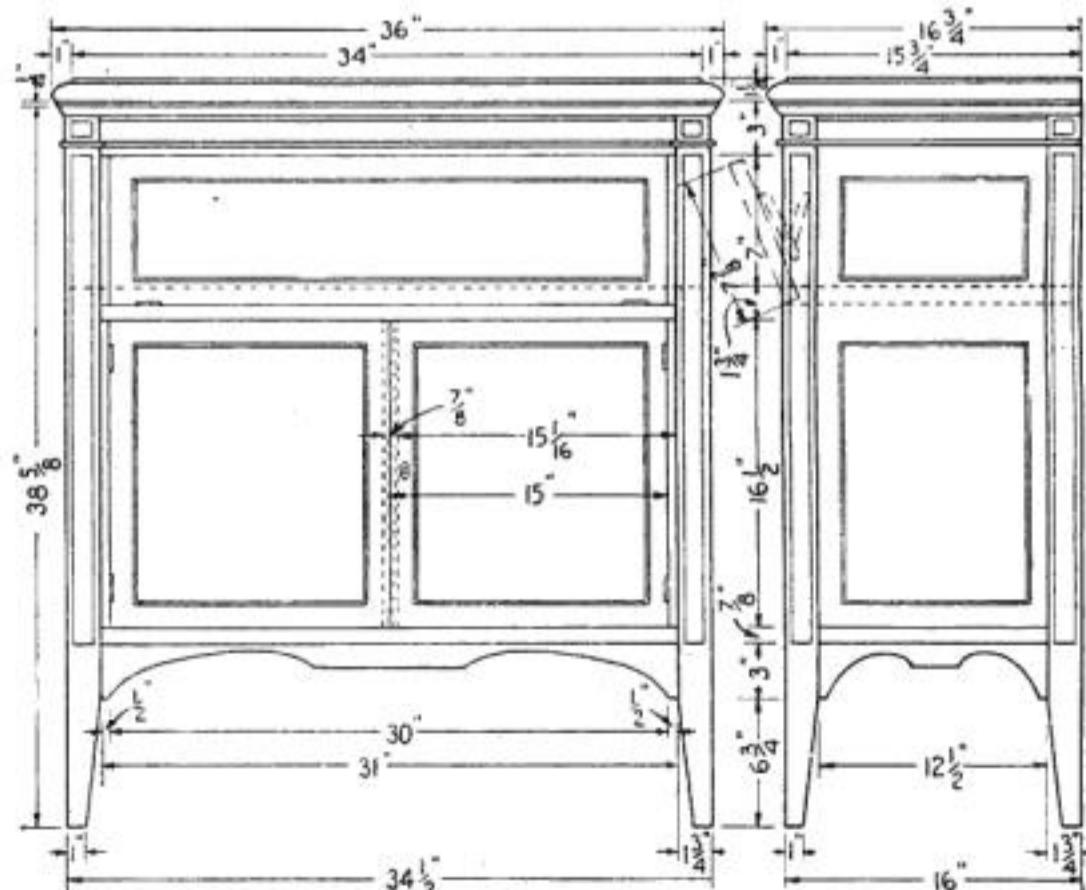
butterfly design, placed upon the outside of the door and case; thus no fitting will be necessary. The desk lid may be supported by chains fastened by plates or stout screw eyes instead of the elbow supports indicated.

If a more elaborate case is desired, one of the alternate designs of feet shown on Blueprint 70 may be bandsawed. The center of the end panels and doors inclosed by the inlay may be carefully removed, the under layer of the plywood made smooth, and crotch grain mahogany veneer laid and glued by rolling and rubbing down. In doing this do not wet the veneer.

To do such veneering properly there must be plenty of hand-screws and other appliances for veneering, and the worker must be sure that he has the skill necessary to handle hot glue effectively. The gluing problem may be helped by using casein glue, which sets much more slowly than hot glue.

More elaborately designed and wider inlays may be purchased from dealers who supply the furniture trade. A monogram made of strip inlay or ornamental inserts bought ready made may be placed in the center of the panels.

**A doll's house of Colonial design and a new ship model are the blueprint projects scheduled for the December issue.**



Front and end views of the cabinet. Inlaid bandings, which may be bought ready made, are suggested for decorating the doors and end panels, and thin inlaid lines for the legs

GOODELL - PRATT



Inside Micrometer—618. Gauges the precise diameter of any automobile cylinder from 2 to 6 inches, showing maximum—for re-boring or grinding. Extra rods are inserted for diameters above 2 inches. Barrel clearly etched and easy to read. Extra rods carried in hollow handle. Long handle reaches where hand cannot. Hardened steel anvil adjustable to compensate for wear. Complete, \$12

Outside Spring Calipers—500. For transferring measurements to steel rule. Every part subject to wear is hardened. Legs are hard crucible steel. Stiff, properly tempered springs. Extra-long screw gives greater measuring capacity. Size 2½ inches. With Solid Nut. . . . \$0.95

Feeler Gauge—359. For gauging gaps, as in spark plugs, platinum points and valve tappets, etc. 9 leaves, 2½ inches long—½ inch wide. .0015 to .015. Used in combination, these will measure any gap from .0015 to .0615. . . . \$1.80

Steel Rule—213. Light Tempered. 6 x ½ x 1/20 inches. Clearly graduated both sides and ends. Accurate in between as well as over all. . . . \$1

Micrometer Depth Gauge—31-R. With 3 rods, for measuring slots, holes, etc., from 0 to 3 inches, by 1/1000ths. Ratchet mechanism. Base 2½ in. x 11/32 in., hardened, ground and accurately lapped at right angles to rods. . . . \$11



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Valve Lifter—596. All-steel. Powerful enough to compress and hold any valve spring. Jaws move on hardened rollers. Screw turns on ball bearings. Takes positive hold; doesn't slip or catch fingers. Nicely polished. . . . \$2.75

Valve Grinder—288. Takes the drudgery out of the job of grinding valves. Crank turns in one direction as on hand drill, but spindle oscillates back and forth. Enamelled iron frame. Over all length, 10½ inches. Weight 3½ pounds. . . . \$4

Goodell-Pratt Electric Drills. Sizes ½ to ¾ inch. Light and Heavy Duty, for 110 and 220 A.C. or D.C. Steady drilling doesn't overheat these drills. Self-oiling bearings require only occasional attention. Vital parts readily accessible. These drills retail from . . . \$36 to \$99

Mechanic's Vise—370. Tough steel jaw faces, scored and case-hardened, 3 x 1½ inches, opening 4½ inches. Steel Feed Screw with square thread, and 1½ inch guide rods, insure great rigidity. Iron parts red and black enameled; steel parts polished. Weight 40 pounds. \$16

Micrometer Caliper—2-R. Measures diameters up to 1 inch by 1/1000ths. Drop-forged frame; ratchet mechanism; locking device to hold screw at any desired position. Compensation for wear provided. . . . \$12



THE ten automobile repair tools pictured here are single examples of the sizes in which each is made. The catalog also features all kinds of tools for machinists, and professional and amateur mechanics.

## Tools that SPEED UP automobile repair work

You'll find them all in this free 400-page catalog

**Valve Lifters**—that raise and hold positively—never slip or catch fingers. **Valve Grinders**—that make valve-grinding as easy as hand drilling, and lift your fingers clear of the vertical cylinder-head bolts. **Feeler Gauges**—that take the guesswork out of spark-plug, platinum-point and valve-tappet adjustments.

**Electric Drills** that drill steadily hour after hour on the most gruelling job, without distress or overheating. The ½-inch Heavy Duty Goodell-Pratt Electric Drill goes through ½-inch cold rolled steel in 13 seconds. **Precision Tools**—that tell depths and diameters, lengths

and outside measurements, accurately, to the thousandth of an inch.

These and many more good automotive tools are pictured and described in the Goodell-Pratt 400-page Catalog shown above.

Some of these tools will be new to you—will show you quicker, more convenient ways in automobile repairs and adjustments.

These tools are sold by good hardware stores, mill supply houses and automotive supply dealers.

The catalog is *free*. Write for it. Select the tools you want. Then see your dealer.

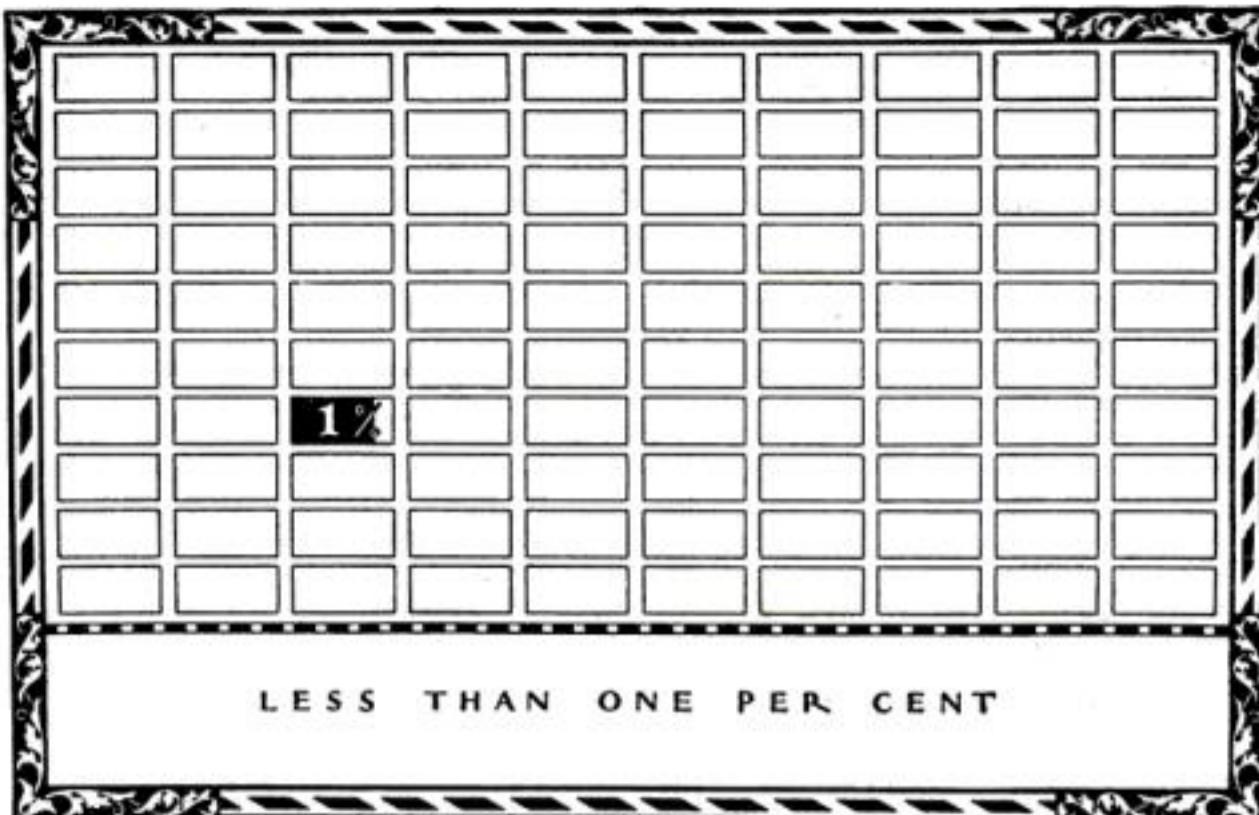
GOODELL-PRATT COMPANY, GREENFIELD, MASS., U. S. A.

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MAKERS OF *Footsmiths* MR. PUNCH

# GOODELL-PRATT

1500 GOOD TOOLS



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The company is owned by more than 420,000 people, with stockholders in every section of the United States. It, in turn, owns 91% of the common stock of the operating companies of the Bell System which give telephone service in every state in the Union, making a national service nationally owned.

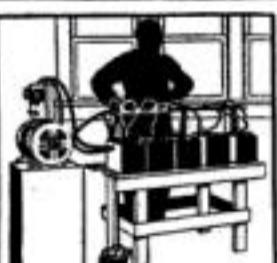
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Company are the largest single body of stockholders in the world and they represent every vital activity in the nation's life, from laborer and unskilled worker to wealthy and influential executive. Although the telephone was one of the greatest inventions of an age of large fortunes, no one ever made a great fortune from it—in fact, there are not any "telephone fortunes." The Bell Telephone System is owned by the American people. It is operated in the interest of the telephone users.

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Charge batteries in 1-2 the time required by others. Latest method recommended by the leading battery companies and approved by the U.S. Bureau of Standards. BIG YEAR ROUND PROFITS. Best paying business in automotive field. Requires no special experience, uses small space. 30 days free trial at our risk under absolute money back guarantee. Write today for full particulars. **HOBART BROS. CO., Box P-117, TROY, OHIO.**

ONLY \$16.50 MONTHLY



**A2cStamp**  
—will start you on the road to success. See Money Making Opportunities on pages 146 to 174.

**You Get Bigger Bargains from Boice!**

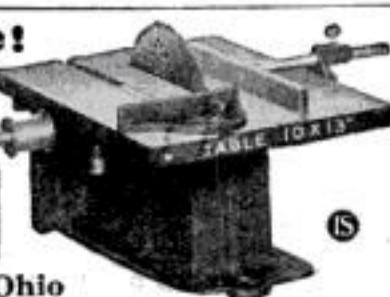
Boice's new low prices on his Bench Machines give you still greater value than ever before. Write for 64-page booklet containing helpful information and describing Boice-Crane Circular Saws, Band Saws, Lathe, Journeymen, Drills and Mortisers.



New Boice Saw!  
Greatest Saw value ever offered. Boice's latest Universal Handisaw now ready. Combination Sliding Table Saw and Jointer. Priced remarkably low. Write for full details before you buy any saw.

W. B. & J. E. Boice

Dept. P. S. 11-C Toledo, Ohio



# How to Repair and Polish Furniture

By CHELSEA FRASER



Shallow depressions and cracks may be filled with stick shellac or sealing wax

YOUR furniture is subject to all sorts of accidents. Some of these are very easily concealed; others are likely to challenge your knowledge and skill a good deal more than the scuff and surface blemishes mentioned last month in my article, "Patching Damaged Furniture."

When a piece of furniture receives a square blow from some hard object, the extent of the dent or bruise governs the method of repair. If the bruise is shallow, drop a little water into the depression, using the tip of a finger. Then lay a damp blotter or piece of felt over it. Place a marble or the round end of a thimble on the blotter, directly over the dent, and press it into the cavity with a moderately hot flatiron, as shown in Fig. 1, page 94. Keep the iron in position so as to cause steam to penetrate into the wood fiber below. The cells will slowly swell and the contusion grow less and less.

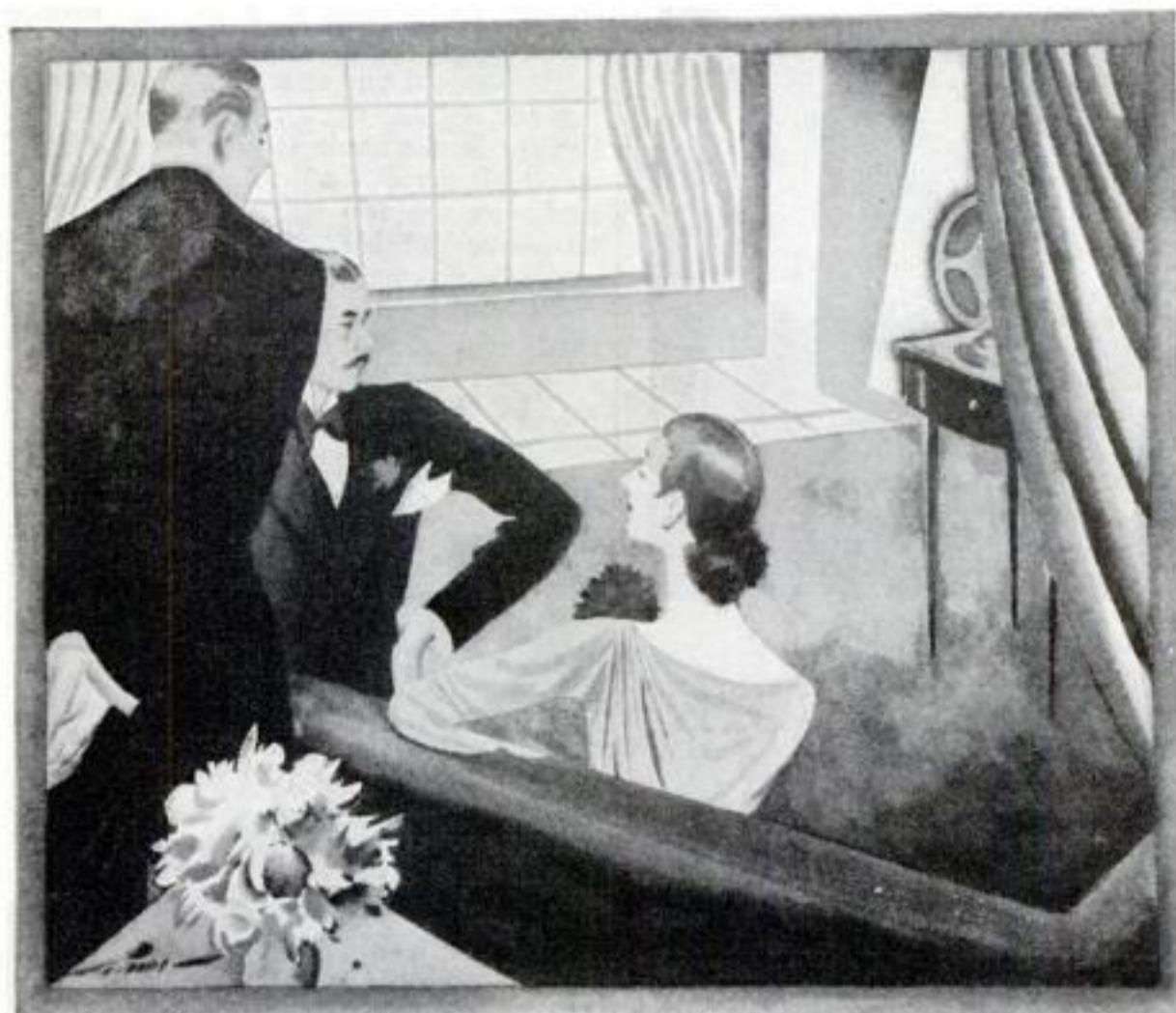
When the bottom of the defect comes up to the main surface, the only thing that remains to be done is to rub the spot. Sprinkle a few drops of sewing machine oil or olive oil on the damaged surface, add a small pinch of FF pumice powder, then lightly rub the fine oil-mixed grit until the abraded varnish has been freshened up and appears uniform with the remainder of the surface.

Should any white show around or in the bruise, mix a little stain (aniline colors soluble in water, or household dyes for wool, which were mentioned last month) with liquid shellac to match the finish. A thin application of this will dry in fifteen or twenty minutes, whereupon another coat should be added, to give body to the surface. Rub the new film lightly with a felt-covered block until the glare of the shellac has been softened to match the original finish.

Some bruises are far too deep to be effaced by swelling the wood fiber. These, like nicks or spots where wood has been knocked out, re-

(Continued on page 94)

# ...Modern



## Radio is better with *Battery Power*

NOT because they are new in themselves, but because they make possible modern perfection of radio reception, batteries are the modern source of radio power.

Today's radio sets were produced not merely to make something new, but to give you new enjoyment. That they will do. New pleasures await you; more especially if you use Battery Power. Never were receivers so sensitive, loud-speakers so faithful; never has the need been so imperative for pure DC, Direct Current, that batteries provide. You must operate your set with

current that is smooth, uniform, steady. Only such current is noiseless, free from disturbing sounds and false tonal effects. And only from batteries can such current be had.

So batteries are needful if you would bring to your home the best that radio has to offer. Choose the Eveready Layerbilt "B" Battery No. 486, modern in construction, developed exclusively by Eveready to bring new life and vigor to an old principle—actually the best and longest-lasting Eveready Battery ever built. It gives you Battery Power



Here is the Eveready Layerbilt "B" Battery No. 486, Eveready's longest-lasting provider of Battery Power.



for such a long time that you will find the cost and effort of infrequent replacement small indeed beside the modern perfection of reception that Battery Power makes possible.

**NATIONAL CARBON CO., INC.**  
New York  San Francisco  
*Unit of Union Carbide and Carbon Corporation*

Tuesday night is Eveready Hour Night  
—9 P. M., Eastern Standard Time

WEAF—New York  
WJAR—Providence  
WEEI—Boston  
WF1—Philadelphia  
WGR—Buffalo  
WCAE—Pittsburgh  
WSAI—Cincinnati  
WTAM—Cleveland  
WWJ—Detroit  
WGN—Chicago

WOC—Davenport  
WCCO—Minneapolis  
KSD—St. Paul  
WDAF—St. Louis  
WRC—Kansas City  
WGY—Schenectady  
WHAS—Louisville  
WSB—Atlanta  
WSM—Nashville  
WMC—Memphis

Pacific Coast Stations—  
9 P. M., Pacific Standard Time  
KPO—KGO—San Francisco  
KFOA—KOMO—Seattle

KFI—Los Angeles  
KGW—Portland

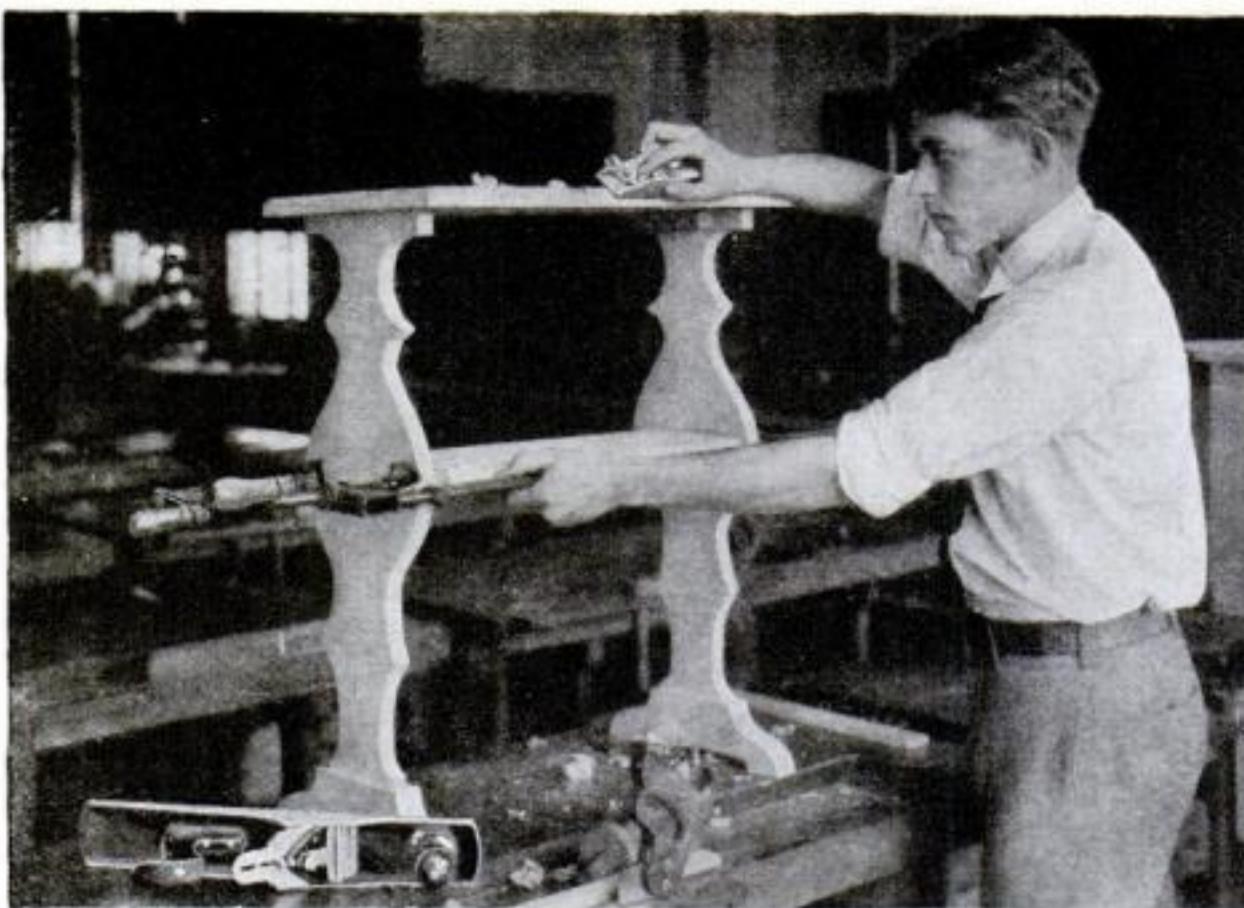
# EVEREADY

## Radio Batteries

*—they last longer*

The air is full of things you shouldn't miss

 This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



## Better tools mean better work

THE Sargent Auto-Set Plane is so strongly made that you should never need to replace it. It is so moderately priced that you cannot afford to be without it. It is so carefully and accurately fitted that the chromium steel cutter seems a solid part of the plane itself, and cuts with, across, or against the grain without chattering. Sargent Auto-Set Planes insure clean, accurate work. They can be quickly and exactly set at any adjustment. *and the cutter*

*can be taken out, sharpened and replaced in the original position without disturbing adjustment.*

Sargent planes are used by carpenters and wood-workers everywhere. The Auto-Set and the small Steel Block Plane also illustrated here will finish any job. Ask your dealer to show you Sargent planes and write us for catalog and further particulars. **Sargent & Company, Manufacturers, 50 Water Street, New Haven, Conn.**

## SARGENT PLANES

Sargent Steel Block Plane No. 5206



Sargent Auto-Set Bench Plane No. 714

## Chemical Tricks for Boys



Surprise and puzzle your friends with magic chemical tricks; make ink; dye cloth; test water and soil; write secret letters with invisible ink; pour blue, brown and black liquid from a pitcher of water. All these and many more chemical stunts are easy with ChemCraft Junior. It's the best box of fun you ever had! Get yours now.

ONLY 25¢ POSTPAID

FREE Magazine of the ChemCraft Club to every boy who writes for it now. Full of new ideas and chemical stunts. Ask for yours!

The Porter Chemical Co. 115 Summit Ave. Hagerstown, Md.

## Better Than A Brush



The Lacquer-Well Spray Gun for all brushing lacquers including brushing Duco.

### Anyone Can Work It

Lacquer your auto, screens, etc. Make your old furniture like new. Every home workshop should have one.

Sent postpaid anywhere in U. S. upon receipt of \$2, extra tanks 25¢.

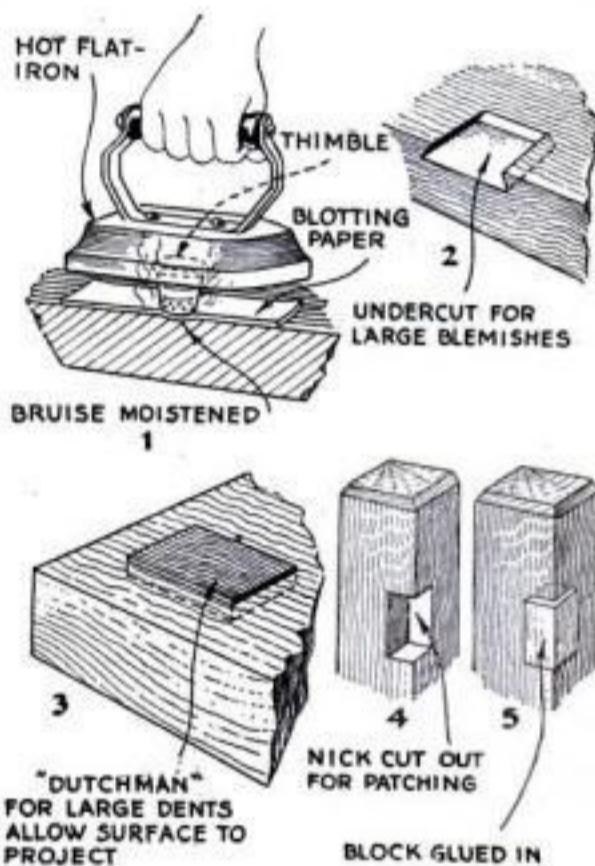
THE LACQUER-WELL SPRAY  
2018 E. 105th St. COMPANY Cleveland, Ohio

## How to Repair Furniture

(Continued from page 92)

quire filling in order to make them look well.

For surface bruises and nicks not greater than  $\frac{1}{2}$  in. across, use either stick shellac or sealing wax of the proper color, applied with a hot screw driver (either an old one or a cheap tool worthless for regular work). To fill larger defects it is advisable to insert a patch of wood, often called a "dutchman." Shellac and wax are too brittle in large areas to prove durable. As a substitute for a patch, you can use a commercial plastic wood preparation, glue and wood dust, or a gesso mixture, the preparation of which was described in the preceding article. Especially with corner or edge



Methods of treating bruises, undercutting blemishes to be filled, and applying patches

defects avoid the use of shellac or wax, for it is likely to chip out when struck.

Where the cavity is shallow but large in extent, and stick shellac or wax seems the best filler to use, deepen the hole with a knife or chisel, undercutting the edges a trifle (Fig. 2, above) so as to afford the filling a sort of anchorage. Even when applying gesso or glue and wood dust, the deepening and undercutting of shallow depressions is to be recommended.

As a rule, a better job of repairing will be done in the case of large holes and certainly on all really fine work, if a wooden patch is inserted.

The new wood should be as nearly like the original wood as possible. You must be careful to cut it out in a form to have its grain run in the same direction as the grain of the main stock, as in Fig. 3; and it is best, of course, to make the patch diamond-shaped rather than rectangular to avoid a hard straight line across the grain at each end.

It is usually wise to make the dutchman before straightening up the cavity it is to enter. Use a plane to get the ends and edges of the patch perfectly level. Hold the plane inverted between your knees while you grasp (Continued on page 96)

30<sup>th</sup> FREE  
A DAY  
STRIAL

## Battery or All-Electric OPERATION

HERE is the great value offer of the day. Test and try this powerful seven-tube RANDOLPH RADIO for thirty days. After it brings in stations from near and far with amazing clearness—with easy one-dial tuning—after it easily equals any radio you have heard—after you are more than satisfied then you can buy it direct at factory prices. Every RANDOLPH must make good before it is sold.

The RANDOLPH SEVEN-TUBE CONSOLE illustrated here can be had for use with batteries or connected direct to the electric light socket—absolutely batteryless—no batteries, chargers or acids—just plug in and tune in. 100% efficient either way. Its construction and performance have been tested and approved by leading radio engineers and authorities—by leading radio publications and laboratories.

### 7 Tubes—Single Control Illuminated Drum

One drum dial operated by one simple vernier control tunes in all stations with easy selectivity to tremendous volume. No overlapping of stations. Illuminated drum permits operation in the dark. Volume control for finer volume modulation. This is a seven-tube tuned radio frequency receiver with power transformers and power amplification. Space wound solenoid coils. Full and completely shielded. A real receiver of the highest quality. Tremendous distance, wonderful tone quality, simple to operate.

### Beautiful Walnut Console Built-in Cone Speaker

The Randolph Seven-tube Ampliphonic Console illustrated above is housed in a genuine burl-walnut cabinet with two-tone hand rubbed finish giving it unsurpassed beauty. The same expert cabinet work has gone into the making of these consoles as in the finest furniture. Has built-in genuine Amplion cone loud speaker of the finest quality. Accurately reproduces complete range of musical notes from the highest to the lowest pitch.

### What Users Say

I have logged more than 50 stations from coast to coast.—Lloyd Davenport, Littlefield, Texas. I have logged 52 stations from Cuba to Seattle, the set is a world beater.—J. Tampkinson, Detroit, Mich. Your set is a revelation, has all others tied to the post for distance and selectivity.—Waldo Powers, Vergennes, Vermont. On strength of its performance sold two more sets this week.—T. Scanlon, Orlando, Florida.



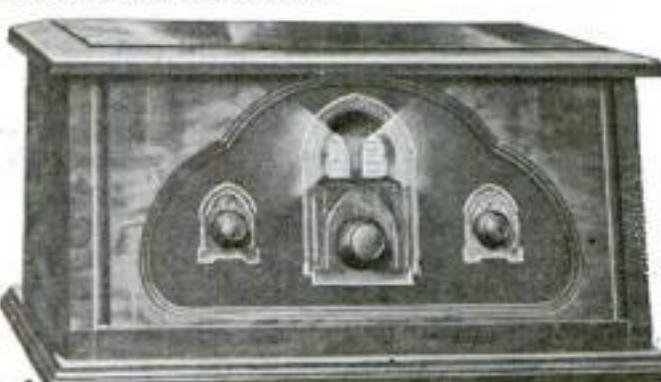
*The Randolph*  
7-Tube Console  
Single Control  
RETAIL PRICE  
Completely Assembled

\$ 99

Sensationally Big  
Discounts to Agents

Work either full or part time and make big money. Tremendous advertising campaign helps you sell. Regardless of whether you have ever sold before, be sure to get our proposition. The Randolph sells on first demonstration. Men and women both can make first demonstration. Get your demonstration set for thirty day's FREE TRIAL.

MAIL  
COUPON  
NOW!



### The Senior Six

Now you can have a new, modern, single-control, six-tube radio. Do not compare this set with old style 2-dial 6-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers. Comes in a beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated Drum with space for logging. Absolutely dependable and very selective. Sent for 30 Days' Free Trial. You test it before you buy.

6-Tube  
\$ 55  
Retail Price  
Single  
Control

The Randolph Radio Corporation are pioneers in the manufacture of radios. All of its vast and unlimited resources have been used in making and perfecting of the Randolph Receivers. Because of our long and successful experience in the radio business, we are perfectly confident in sending out a Randolph Radio on trial. We know what it will do. Mail us the coupon now for the greatest radio offer ever made.

Randolph Radio Corporation,  
711 West Lake Street, Dept. 227  
Chicago, Illinois.

Send me full particulars about the RANDOLPH Six and Seven-Tube All-Electric and Battery Table and Console Sets with details of your 30 Day FREE Trial Offer.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

Mark here  if interested in Agent's proposition.

USE THIS COUPON NOW!

RANDOLPH RADIO CORPORATION  
711 West Lake Street Dept. 227 Chicago, Illinois



## You can tell by his hammer

The man who isn't satisfied with anything he builds or "fixes" unless it's absolutely right is the kind that gets real satisfaction and pleasure out of owning and using Maydole Hammers.

If you're that kind of man, there's only one make of hammer for you—the genuine Maydole. Grip one in your fist. Feel its superb "hang." Remember that the head is *press-forged* of selected tool steel and the handle is of clear, second-growth hickory, air-dried for years and put on "for keeps." You'll recognize it for what it is—the finest hammer that specialists in hammers for over eighty years can produce.

Ask your hardware dealer to show you a Maydole in whatever style or weight you need.

Write us for a free copy of our valuable and interesting Pocket Handbook No. 23 "B." You'll find it useful.

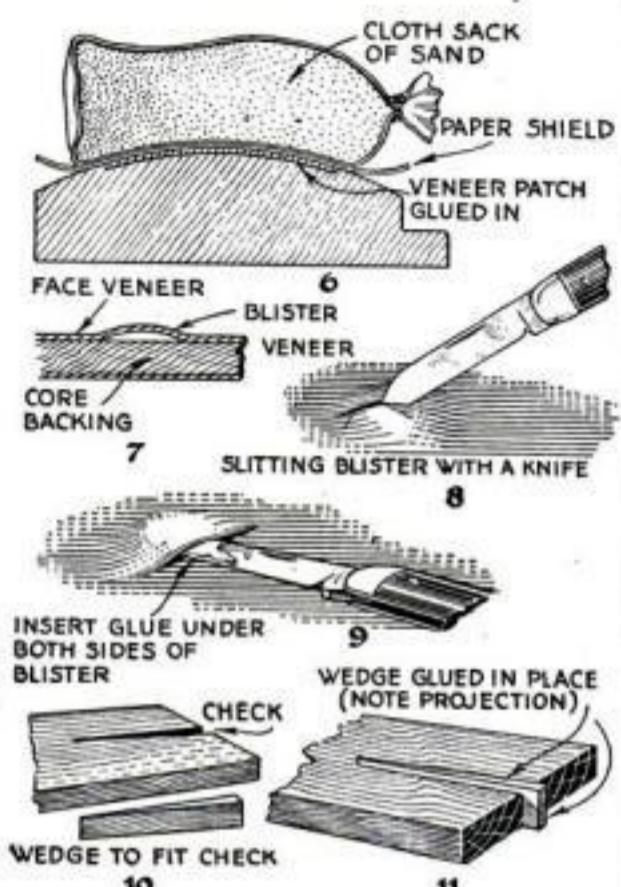
YOUR HAMMER SINCE 1843  
**Maydole**  
**Hammers**

The David Maydole Hammer Co., Norwich, N.Y.

94

## How to Repair Furniture

(Continued from page 94)



How to patch veneer on a curved surface, glue down blisters, and fill checks or cracks

the block in your hand and draw it across the fine-set cutter. Level the faces of thin pieces with a hand scraper, or sandpaper wrapped around a block.

Lay the patch over the blemish, with a suitable projection at the edge or end if a border job is being done, and trace around it with the small or "pen" blade of your knife. This will leave a whitish outline on the varnished surface. Then, with the knife or a chisel, deepen the outline and hollow the interior wood to the correct depth. Make the bottom of the recess as level as possible.

Try the patch in the opening. If it is too loose, you can either make a new patch, or glue it in as it is and later fill the interstices with stick shellac or sealing wax. If, on the other hand, the patch is too tight, pare it away carefully to fit. See Figs. 3, 4 and 5.

Use either hot or cold glue and coat all surfaces that will unite. Press the patch into place with the head of a hammer and rub the head back and forth, but do no striking. Dampen a cloth in warm water and quickly wipe off all surplus glue. Over the patch place a blotter or a pad made by folding paper or cloth, and exert some sort of pressure to keep it in place until the glue dries. On horizontal surfaces you can use a flatiron or other weight; in some places clamps can be applied, or thin strips of wood sprung, bowlike, between a block covering the pad and an overhanging portion of the cabinet. On perpendicular surfaces which cannot be shifted to the horizontal, such as the leg base of the piano illustrated on page 98, you may have to use twine or tape.

If you cannot get the same species of wood for making the patch, select a wood of similar texture. Then, after the patch has been laid and dressed, you can conceal it by the process called "graining." Stain powders

(Continued on page 98)



IT'S just a step from the wall-flower's corner to the center of popularity ring. Don't let the other fellows capture all the good times, and the smiles of those whose smiles are worth while. Be the whole show with your

**BUESCHER**

## True Tone Saxophone

This is the one instrument that you know you can learn to play. If you can whistle a tune you can't fail with a Buescher saxophone. You can learn to play quickly, with comparatively little effort.

### Join the Home Town Band

With the aid of the 3 lessons given on request with each new Buescher, many learn scales first hour and play tunes first week. You can teach yourself, and in 90 days join the Band, or play with an orchestra, at good pay.

### Only Buescher Assures Success

But only with a Buescher is this rapid progress assured. You don't have to fuss and frown for certain notes. Just open the key and blow normally. Every tone full, clear and true.

### Six Days' Trial. Easy Terms

Take any Buescher Instrument home for 6 days' trial. If you like it, pay a little each month. Send coupon for beautiful catalog and details of this liberal plan. There will never be a better time to start. Write today.

**BUESCHER BAND INSTRUMENT CO.**  
Everything in Band and Orchestra Instruments  
2130 Buescher Block Elkhart, Indiana



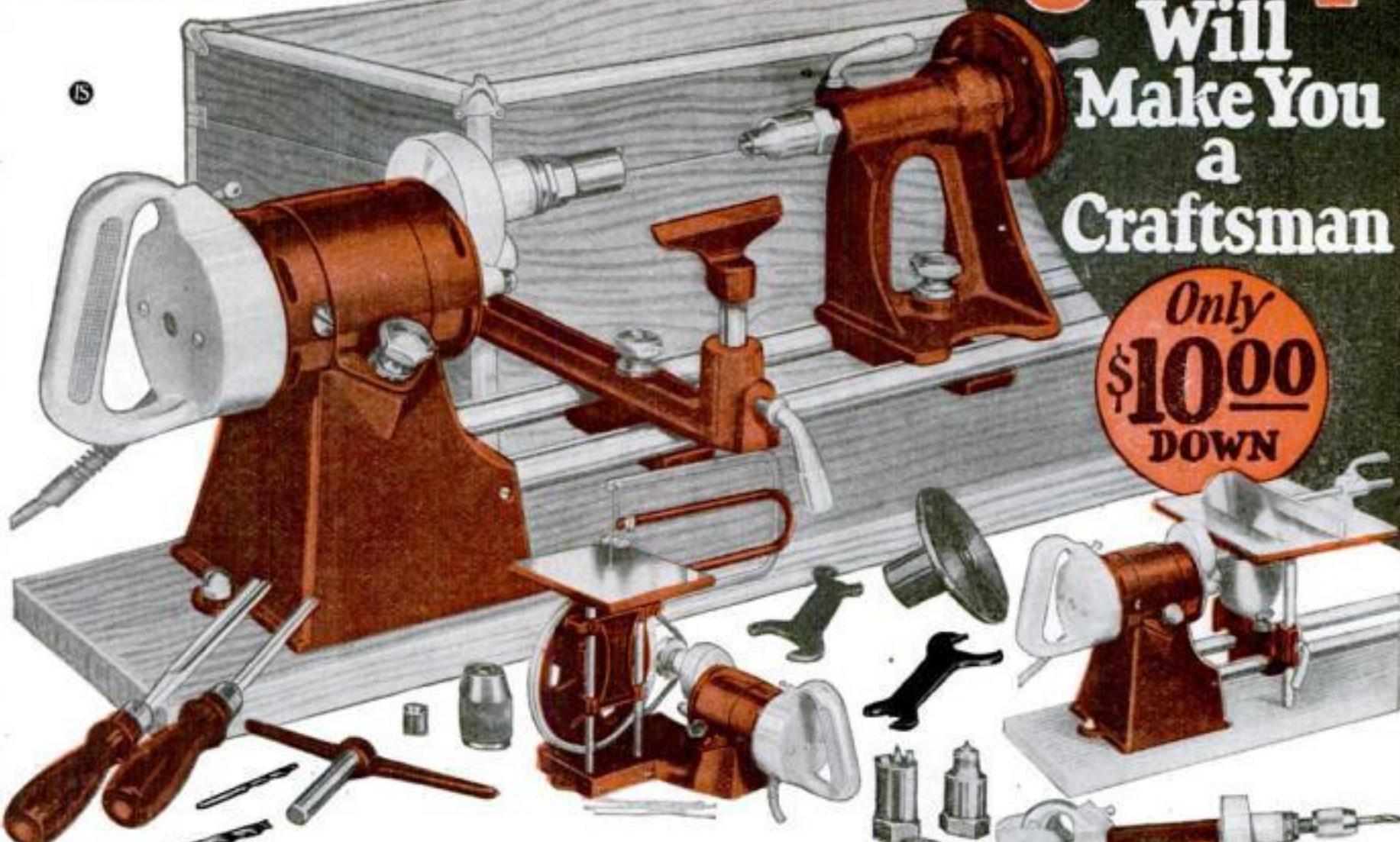
Buescher easy playing Trumpets and Trombones are the choice of the world's leading artists. Mail coupon for special catalog of your favorite instrument.

BUESCHER BAND INSTRUMENT CO., 341D  
2130 Buescher Block, Elkhart, Ind.  
Gentlemen: Without obligating me in any way please send me your free literature. Mention instrument interested in.  
Age: \_\_\_\_\_ Name instrument: \_\_\_\_\_  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_

# This Wonder Working Shop

Will  
Make You  
a  
Craftsman

Only  
**\$10.00**  
DOWN



## A COMPLETE SET of Craftsman's Home Working Tools

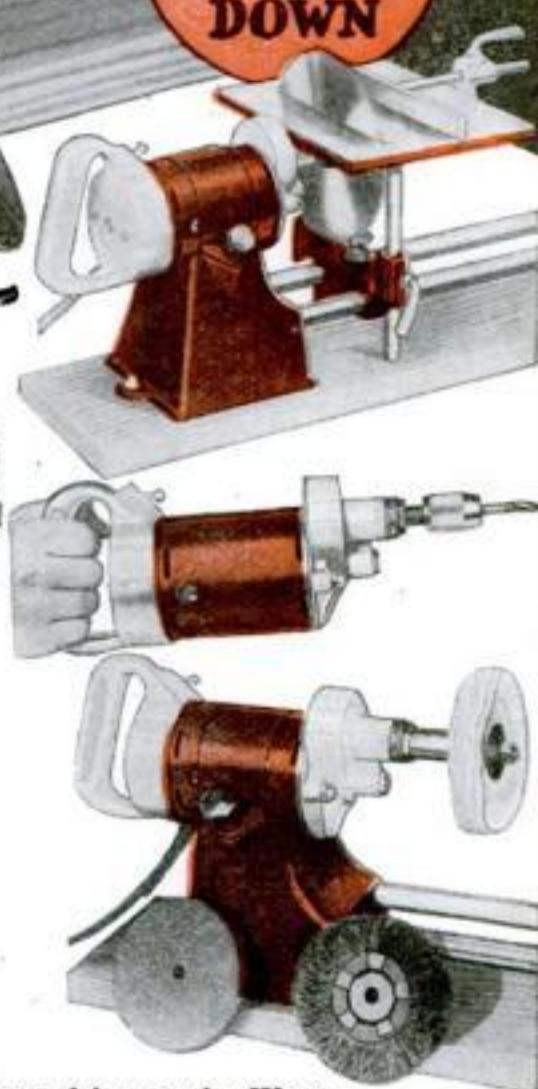
Now! You can make beautiful things at home—You can do "Masterpieces in Wood" with an efficient and powerful set of Craftsman's tools—a complete, portable home work shop set.

All of these tools are made possible by use of the Red Jacket Drill Motor—a most unusual, all purpose electric motor power.

### THE **Red Jacket** HOME WORK SHOP

is a chest full of tools designed by a master for the private use of tool lovers and men who want to build, construct, invent and create at home. It is a complete, made to order, electric work bench that turns out work like magic. Small and compact enough for portable use and so inexpensive that any man or boy may have one. You will be able to make everything—attractive odd furniture—toys, home and garden improvements, all around manufacturing and repairing.

**The Complete Equipment** consists of the new Red Jacket Motor, with direct drive to the Waco Craftsman's wood turning lathe (capacity 9 in. x 34 in.); a bench saw, that has depth and side gauges, scroll and jig saw; and all accessories for both portable and stationary power drilling, buffing, grinding, cleaning, etc. Attaches to any light socket and converts your work bench into a complete private tool and machine shop.



### THE FAMOUS WACO **Red Jacket** GUARANTEE

If our tools are not what you want when you see them, send them back.

LOOK OUT FOR IMITATIONS: There is only one Red Jacket—one Waco—one Wm. L. Aylward, mastercraftsman.

### SENT ON TRIAL

#### Special Crafts Course

And blueprint service is free to Red Jacket Shop owners—all that there is to know about handicraft methods, raw materials, woods, carving, sawing, turning, designing, carpentering, decorating, is taught by special correspondence.

#### Buy On Your Own Terms

Only \$10.00 down. Liberal discounts for cash. Easy monthly payment plans. It is no hardship to own a Red Jacket.

#### Interesting Literature Free

Just send the coupon. You will be surprised with all it contains. Beautiful, Instructive, Fascinating, Interesting.

free  
CRAFTS  
COURSE

free  
BLUE  
PRINTS

10 Days' Free Trial  
Our literature tells you how to start a job of your own. If you are not pleased return the Shop.

2 Ounces  
of interesting reading will be sent you gratis. Send the coupon below. Sit back—see what we send you. It's free.

#### MAIL THIS TO WACO

WACO TOOL WORKS, Inc.  
542 N. Parkside Ave., Chicago, Illinois

Manager, Dept. 11. Please send me particulars about 10-day free trial, free blueprints, and \$10 down payment.

Name.....

Address.....

Turning  
Sawing  
Winding  
Spinning  
Grinding  
Buffing  
Polishing  
Cabinet  
Making  
Scroll  
Sawing  
Drilling  
Repairing  
Dove  
tail  
Pointing  
Jointing  
Sharpening  
Sanding  
Scratching  
Carving  
Successful  
Master  
pieces



## COLORFUL FIBRE- TILE

... *surprisingly low cost*

IMAGINE the beauty of a colorful tiled kitchen in your home!

Your bathroom tiled in one of the smart new color schemes—cool daffodil green, lavender, gray or black.

Upson Fibre-Tile comes in big panel sections—unfinished—ready to enamel in any color your fancy dictates. Made of tough compressed wood-fibre like famous Blue-Center Upson Board—Upson Fibre-Tile cannot crack; cannot chip—and properly applied, should never warp. And it costs but a few cents a square foot—about 1/10th as much as ceramic tile.

### 49 CASH PRIZES FOR BEST USES

We invite you to mail the coupon now and see how you may win one of the 49 prizes for the most effective installations in new or old homes or business.

## UPSON fibre TILE

THE UPSON COMPANY  
1157 Upson Pl., Lockport, N.Y.  
Please send me FREE booklet giving rules of  
\$1500 Prize Contest, together with Upson Fibre-  
Tile and Upson Board samples, helpful suggestions  
and name of nearest Upson lumberman.

NAME  
ADDRESS



Identify genuine Upson  
Board by the famous Blue Center

© The U-Co., Inc., 1927

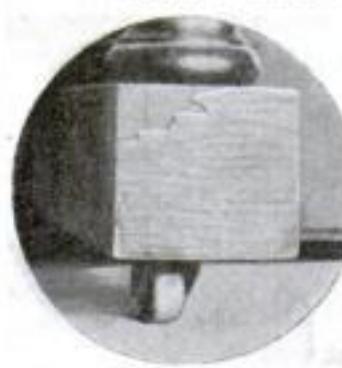
## How to Repair Furniture

(Continued from page 96)

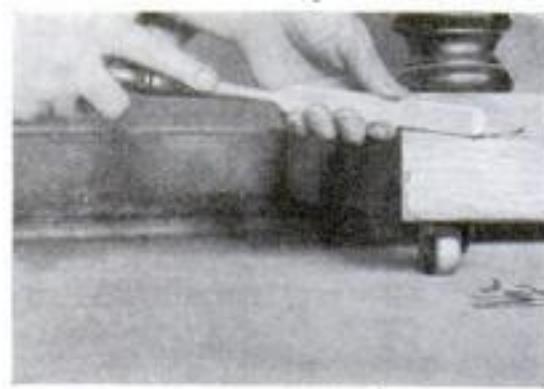
and the turkey burnt umber mentioned last month are mixed with liquid shellac to match the tone of the main surface; then streaks of other shades are worked in with a fine brush to look like the grain markings in the surrounding wood. In this manner you can make a pine patch resemble oak, walnut, or mahogany.

A coat or two of shellac or thin varnish, lightly rubbed down with felt and oil, will restore the original finish and, if skillfully done, make a repair to defy detection except on the closest scrutiny.

If the damaged surface is veneered, either get a piece of similar veneer (your local lumber or furniture dealer perhaps can supply it) or saw out a thin



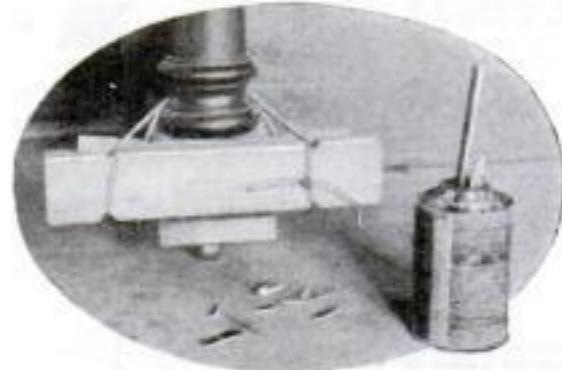
Broken veneer on the leg of an upright piano



The damaged veneer is chiseled away carefully to make a bed for the new wood

piece from thick wood of the same kind. Have the edges as straight as you can, as this insures ease in making tight joints. Make the patch, if it is to be let into the surface like an inlay, a trifle thicker than the depth of the recess after the latter is dressed flat in the bottom. If the blemish occurs at the edge or end, the patch must project a little above and a little beyond to allow it to be dressed level after the glue has dried.

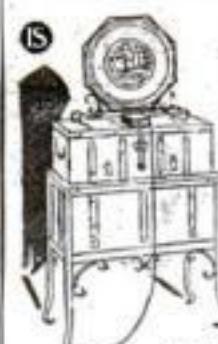
Sometimes, too, you may have to patch veneer on a rounded surface. Make the patch, trace it, and deepen the outline with chisel or knife until the old veneer is cut through. Insert the knife blade flatly at a spot where some of the veneer is gone (Continued on page 133)



How this awkwardly located patch was bound firmly in place until the glue dried

## AT LAST! Control of Radio Reception from Your Easy Chair

Turn set on and off—get station after-station—swiftly—surely—DX—without leaving your easy chair.



The NEW  
*Thermidyne*  
REMOTE CONTROL  
Radio Tuning Unit

No other tuning unit in the world like it. Tune your set from any room of your home. Attached to any single dial receiver with removable dial in a few minutes by removing old dial and attaching adapter plate with Remote Control Unit. Mechanical Model, \$18.00. Electrical Model, \$6.00. West of Rockford, add 10%. Write today for circular describing radio's newest and most revolutionary development.

ALGONQUIN ELECTRIC COMPANY, INC.  
Leo Potter, President

245 Fifth Avenue. New York City

## BUILD YOUR OWN GRANDFATHER'S CLOCK



We furnish blue prints, finishing material and instructions. Buy the works, dial, weights and pendulum from us at surprisingly low prices. You make a fine profit building artistic clocks for your friends.

Plain Works As Low As \$5.00. Others with Chimes at All Prices. Ask for Attractive Free Offer.

AMERICAN CHIME CLOCK COMPANY  
1691 Ruffner Street  
Philadelphia



MEN'S STRAP WATCH  
DIRECT FROM SWITZERLAND  
399  
Radium Dial  
Jeweled Movement  
Silveroid Cushion Shaped Case

This fully guaranteed watch cannot be manufactured in America for less than \$12. Genuine leather strap. Accurate—durable—handsome. SEND NO MONEY. Pay on delivery \$3.00 plus postage. "FEDCO", U. S. Swiss Agents, 561 Broadway, New York City, Dept. W-18

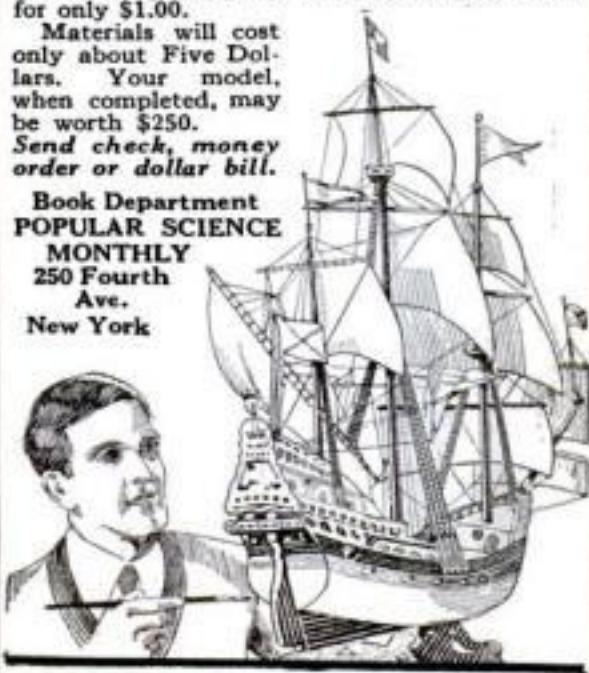
## Build This Gorgeous SPANISH GALLEON

Complete Instructions and Plans Only \$1.00

One of the most colorful and beautiful of ship models—designed for Popular Science Monthly by the famous model builder Captain E. A. McCann. Anyone can make it who can use tools. We supply complete description and instructions, together with photographic reprints of important parts, and a reproduction of the galleon in full color, complete detail charts, together with two full size Blue Prints. All mailed postpaid in a handsome container for only \$1.00.

Materials will cost only about Five Dollars. Your model, when completed, may be worth \$250. Send check, money order or dollar bill.

Book Department  
POPULAR SCIENCE  
MONTHLY  
250 Fourth  
Ave.  
New York



# BUILD OLD IRONSIDES

for \$6.98

\$6.98

You can build a model of the United States Navy's most famous fighting vessel in a few hours of pleasant pastime.



Size: 30 inches high; 32 inches long; 10 inches wide. An exact duplicate of the U. S. S. Constitution in every detail.

Fifteen-year-old Carl Rayborn built a model of the Constitution using only our cut-to-fit and ready-to-assemble parts as supplied in our kit for \$6.98. He submitted the completed model in a contest by the publishers of Science and Invention, and it

## WON FIRST PRIZE

in competition with a thousand ship models submitted to the magazine by builders from all parts of the country. Previous to building the model of Old Ironsides, Carl Rayburn had never constructed a ship model in his life.

You, too, can build a prize winning model from our cut-to-fit and ready-to-assemble parts of historic ships, including the Constitution, the Mayflower, the Santa Maria and the La Pinta. Prices for the kits of parts range from \$4.98 to \$6.98.

You need not know anything about ship building or carpenter work in order to build one of these ships. No special knowledge of ship model building is necessary either. THE WORLD'S LARGEST BUILDERS OF SHIP MODELS AND MELODY SHIPS WILL supply all the parts from the hull down to the smallest piece of rigging, all cut to fit and ready to assemble. You cannot go wrong. Diagrams and plans of parts that are included with each kit tell exactly what to do with each part.

These plans show you step by step just how the model is constructed. Everything is made so simple that even a small child can build a beautiful model.

All you need is a small hammer to tap the parts into place. Here is part of the instructions copied word for word from the diagram and instruction sheet that goes with the kits. "Take part No. 57, place it in front end of part No. 56 and tap lightly with a hammer. Next take part No. 58 and place it up against No. 57 and tap it with a hammer to bring it into place."

Canadian prices slightly higher.  
Send all Canadian orders to Canadian office.

Easy! Nothing simpler. The instructions are like that from beginning to end. Do this and that and before you realize it a beautiful ship model has grown before your eyes.

The model of the Constitution is exact in every detail. The hull, masts, spars, riggings, cannons and anchors are exactly like those on the original ship. Those who have constructed models from our cut-to-fit parts are so well pleased with them that they will not sell them for \$50 or even \$100. We have letters from all over the world telling us how much pleasure it was to build these models and the enticing money offers the builders have received from them when completed. Many persons have built up a wonderful business selling completed models which they have made from our kits.

If, after assembling the model you do not think it worth many times the purchase price, return it to us in good condition and we will gladly refund your money.

Write for our free beautifully illustrated catalog which contains photographs of all our models, together with complete details and price of each. We will send this catalog without obligation to you. Fill in the coupon below and we will act upon it immediately.

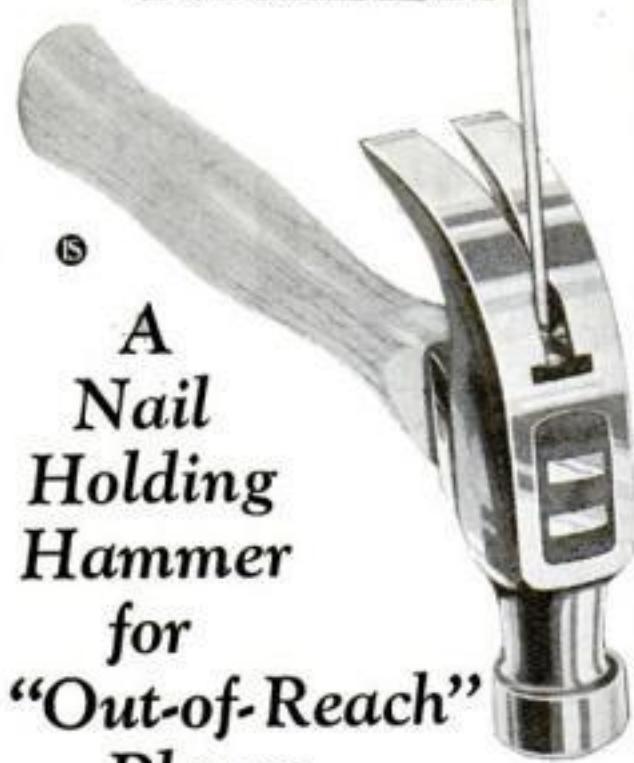
MINIATURE SHIP MODELS, INC., DEPT. 02.  
3818-20-22-24 Baring St., Phila., Pa.

Please send me the complete parts, cut to fit, and ready to assemble for the model Constitution. I will pay postman \$6.98 plus postage (a few cents).

PLEASE PRINT NAME AND ADDRESS PLAINLY.

Name.....  
Street or R. F. D.....  
City.....  
State.....

# The Cheney NAILER



How often you have had to drive nails from some difficult or even precarious position where it was impossible to free both hands. The convenient Cheney Nailer Hammer was designed to make jobs like that easy.

The Cheney Nailer holds any nail securely while you set it where you want it with one stroke—a single blow often drives the nail half way in. And the weight of the hammer releases the nail quickly and easily after it is set.

The best of it is, the nail-holding arrangement on the Cheney Nailer is no trick attachment—it is an integral part of the hammer, a practical device that always works. And every other feature of the Cheney Nailer from its well-tempered tool-steel head, to its strong second-growth hickory handle is Cheney designed and Cheney made and is right from start to finish. Try the Nailer on your next job.

1296



PRENTISS VISE CO.  
106-110 Lafayette Street  
New York City

## Home Workshop Chemistry

Simple Formulas that Will Save Time and Money



**O**XALIC acid forms colorless crystals which may be obtained at almost any drug store or chemical supply house.

From twelve to fourteen parts of the crystallized acid are soluble in one hundred parts of cold water and only from three tenths to four tenths parts in hot water. Cold water, therefore, should be used for dissolving the crystals. One ounce of the crystals placed in an eight-ounce bottle and then filled with water will make a concentrated solution.

Oxalic acid is very poisonous and its solution destroys many colors. For this reason it is often used as a bleach. It forms colorless salts with iron that are soluble; for this reason it is an excellent chemical to remove stains of rust and iron inks.

One of its uses is to clean aluminum pans. Aluminum does not tarnish readily in ordinary use, but alkalies discolor it and it should not be washed in strong soapy water. Discolorations may be rubbed off with whiting (precipitated chalk) or dissolved by dilute oxalic acid in the proportion of one part of water to one part of a concentrated acid solution. The acid must be removed by washing the aluminum in water.

In removing rust or iron ink stains, either the material is placed in a shallow dish containing the acid or the acid is lightly rubbed on until the stain disappears. Another way is to soak blotting paper in the concentrated acid and allow it to dry. When a stain is to be removed, place the treated paper on the stain and moisten the blotter. The stain will usually disappear in a short time. The color of many colored materials is removed by this process, so care should be taken.

A stain and varnish remover may be prepared by adding  $\frac{1}{2}$  oz. alcohol and  $\frac{1}{2}$  oz. sodium sulphate to  $\frac{1}{2}$  pt. concentrated solution of oxalic acid. This will remove the softer varnishes and bleach the stain beneath. Rub down or scrape about five or ten minutes after applying.

The following label is intended to be pasted on the oxalic acid container:

### Oxalic Acid

$C_2O_4H_2$

OXALIC acid may be kept in any convenient glass container. It is poisonous.

A larger portion of the acid is soluble in cold water than hot water. The acid also is soluble in alcohol.

It is a bleach and destroys many colors and stains. Removes iron rust stains and iron inks. Bleaches wood as well as fabrics. Removes old shellac, soft varnishes and wood stains when alcohol or alcohol and sodium sulphate are added.



Using oxalic acid to bleach stained wood

# SpeedWay Shop

**Try It 10 Days Free**  
Use the coupon today and have the privilege of using a SpeedWay Shop in your own home 10 days free. Our big catalog describes 9 models of Shops. Some job men, Contractors, Builders and all sorts of manufacturers can cut costs and increase profits with them. Illustration shows complete working accessories to be used with SpeedWay Shop.

**8 Motor Driven Tools**

1. SpeedWay Drill mounted with Nos. 2 and 3; this makes complete Lathe.
2. Metal carrying case with handle.
3. Saw table and 6-inch blade.
4. Attachments to make Portable Saw.
5. Jig Saw and attachments.
6. Handle to make Portable Drill.
7. Leatherette Case for small parts.
8. Buffer wheel for polishing.
9. Wire Scratch Brush.
10. Emery Wheel—3 inches.
11. Small parts, tools, etc.
12. Handle to make Portable Drill.
13. Leatherette Case for small parts.
14. Buffer wheel for polishing.
15. Wire Scratch Brush.
16. Emery Wheel—3 inches.
17. Small parts, tools, etc.
18. Handle to make Portable Drill.
19. Leatherette Case for small parts.
20. Buffer wheel for polishing.

**Have Fun or Make Money**  
Dozens of men have set themselves up in business with a SpeedWay Shop. In the basement it forms the finest relaxation for professional men and others who love to work with tools.

**Only \$10.00 Down**  
Our terms are very easy. We ship on a down payment of only \$10.00 which is refunded if you do not keep the Shop. Balance is paid in easy monthly payments while you use it.

**24 Free Blue Prints**  
With each Shop we furnish free 24 working blue prints of toys, furniture, pergolas, etc.

### Write for Free Trial Offer

Use the coupon today. Remember, this is the only company in the world making a complete line of Portable Electric Saws, Hammers, Drills, Shops, etc.

ELECTRO MAGNETIC TOOL CO.  
Dept. 5-N. 1830 S. 52nd Ave.  
Cicero, Ill. (Adjoining Chicago)

Please send me free trial offer on Shops.

Name . . . . .

Address . . . . .

# GASOLINE NOW 11¢

AUTO OWNERS HYDRATED BY NEW DEVICE Public Welcomes News

### NEW INVENTION MAKES THIS POSSIBLE

A mysterious whirlwind device that can be installed in a few minutes on any car makes it possible for cars to run on 7% gas. Already thousands of cars have been equipped and are showing amazing mileage tests on gas. Bona fide reports show up to

### 60 Miles On a Gallon of Gas

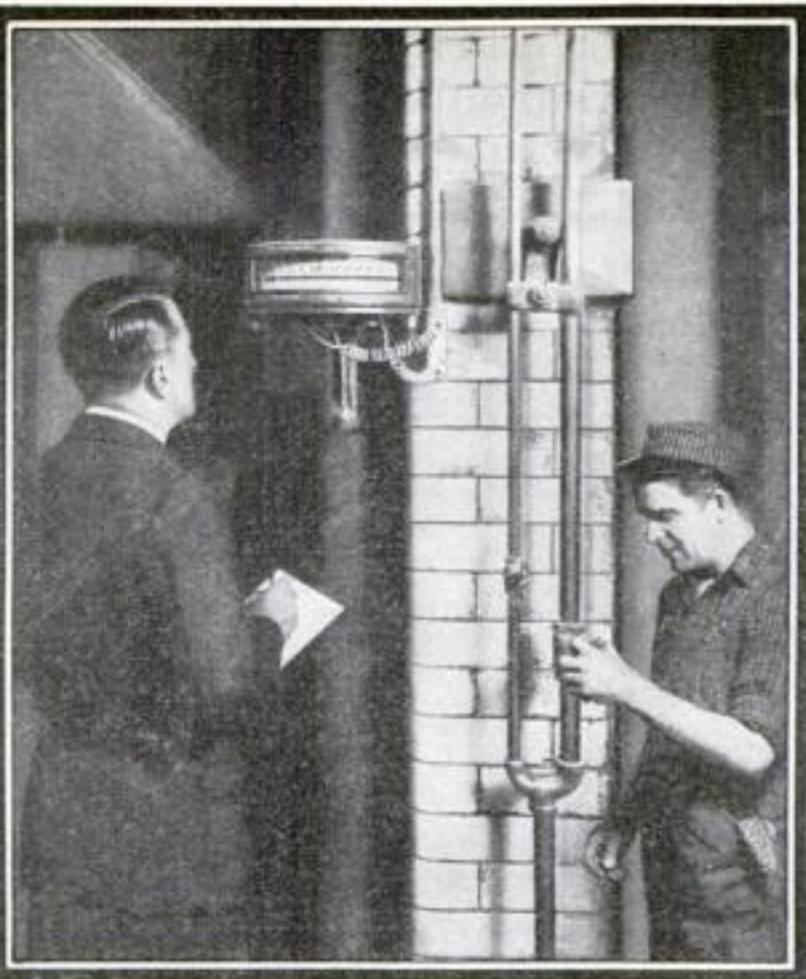
This device not only saves gas but increases power, prevents carbon forming, produces flashy pick-up and quick starting.

### \$100 a Week Territory Open

The demand for the Whirlwind is spreading like wildfire. Men are needed everywhere to take care of local business. \$100 a week is easily possible.

Part time workers can earn \$5 an hour. Write today for this splendid opportunity and free sample offer.

Whirlwind Carburetor Company  
999-499 E. Third St., Milwaukee, Wis.



### Tycos for the Home

**Tycos Office Thermometers**  
An aid in promoting human efficiency.

**Tycos Bath Thermometers**  
To enable you to get the most good from your bath.

**Taylor Home Set**  
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

**Tycos Wall Thermometers**  
To help you maintain a temperature in your house conducive to good health.

**Taylor Quality Compasses**  
To show you the right way in unfamiliar country.

**Tycos Fever Thermometers**  
A necessity in every home.

**Tycos Stormoguide**  
Forecasts the weather twenty-four hours ahead with dependable accuracy.

**Tycos Hygrometer**  
To enable you to keep the humidity of the atmosphere in your home correct at all times.

### Tycos for the Medical Profession

**Tycos Sphygmomanometer**, Pocket and Office types.

**Tycos Urinalysis Glassware**.

**Tycos Fever Thermometers**.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above

Write for Bulletin

## The heating of Office Buildings is controlled by Tycos

EVERY owner of an office building, plant, apartment house or hotel can cut down his bill for fuel by installing *Tycos* Temperature Instruments in his boiler room.

The Chief Engineer of the Metropolitan Life Insurance Company uses a *Taylor* Recording Pyrometer to record furnace and stack temperatures. It insures highest efficiency by keeping furnace temperatures more even—and if the stack temperature rises he can detect and stop at once loss from this inefficiency. Other *Tycos* Instruments are used to measure drafts to show whether or not too many boilers are being used at night. And still another *Tycos* Instrument is used to maintain 140 degrees on the hot water heater. Maintaining this even temperature eliminates possible accidents to tenants from too hot water or "kicks" of no hot water.

By using *Tycos* Instruments this Chief Engineer increases the whole efficiency of his heating plant—and cuts down his fuel bill.

**MANUFACTURERS:**—Whether you use heat for keeping your plant warm or in your manufacturing processes—whether for making armor-plate or baking enamel on cuff buttons, for making cartons or candy, rubber tires or hatching eggs or making tools, firearms or rubber goods or any other products that go through heat treating processes, you need in your plant *Tycos* Instruments for Indicating, Recording and Controlling Temperatures. Increased efficiency and savings can be made in every line of industry by applying *Tycos*—the Sixth Sense.

Write us for literature on any instrument, or type of instrument, and it will be sent promptly. Or, if you prefer, our engineers will consult with you on the application of *Tycos*—the Sixth Sense in your plant.

### Taylor Instrument Companies

Main Office and Factory  
ROCHESTER, N. Y. U. S. A.  
Canadian Plant: *Tycos* BUILDING, TORONTO  
SHORT & MASON, Ltd. Manufacturing Distributors in Great Britain



# THE ~ SIXTH ~ SENSE ~ OF ~ INDUSTRY *Tycos Temperature Instruments* INDICATING ~ RECORDING ~ CONTROLLING

# ATKINS SILVER STEEL SAWs

At  
Your  
Hardware  
Store

## Save When YOU Saw!

A GENUINE ATKINS "Silver Steel" Cross Cut Saw will save you more than it costs.

Only ATKINS can give you "Silver Steel" to make YOUR Saw outlast two or three "cheap" saws, and hold its sharp cutting edge. Only ATKINS can give you a real "segment ground" saw to cut faster and easier through years of hard service.

In leading lumber camps they KNOW the facts and use ATKINS. Why should YOU try to save a little in first cost on a "cheap" saw and pay for it every minute you try to use it? Look for the ATKINS name on the blade of any saw for any use. It means saving in sawing.

E. C. ATKINS & CO.

Established 1857

Leading Manufacturers of Highest Grade Saws for Every Use; Saw Tools, Saw Specialties, Plastering Tools, Machine Knives, Grinding Wheels and Files

428 South Illinois St.  
INDIANAPOLIS, U. S. A.



**S** This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

## Blueprints for Your Home Workshop

ANY ONE of the blueprints listed below can be obtained for 25 cents. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine, in which the project was described in detail, it can be had for 25 cents additional so long as copies are available.



POPULAR SCIENCE MONTHLY  
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose ..... dollars ..... cents:

No.	Title	Described in Issues of	Price
1.	Sewing Table	Feb., '22	25c
2.	Smoking Cabinet	Mar., '22	25c
3.	End Table	Apr., '22	25c
5.	Kitchen Cabinet	May, '22	25c
8.	Shaving Cabinet	June, '22	25c
9.	Arbor, Gate and Seats	July, '22	25c
10.	Porch Swing	Aug., '22	25c
11.	Bench and Tilt Table	Sept., '22	25c
12.	Electric Washer	Oct., '22	25c
13.	Tea Wagon	Nov., '22	25c
14.	Christmas Toys	Dec., '22	25c
15.	Workshop Bench	Jan., '23	25c
16.	Inlaid Radio Cabinet	Feb., '23	25c
17.	Cedar Chest	Mar., '23	25c
18.	Phone Table and Stool	Mar., '23	25c
19.	Grandfather's Clock	Apr., '23	25c
20.	Flat Top Desk	Apr., '23	25c
21.	Colonial Desk	Apr., '23	25c
22.	Cabinet and Desk	Apr., '23	25c
23.	Pergola Garage	May, '23	25c
24.	Gateleg Table	June, '23	25c
25.	Canoe Sailing Outfit	July, '23	25c
26.	Baby's Crib and Pen	Sept., '23	25c
27.	Kitchen-Cabinet Table	Oct., '23	25c
28.	Pullman Play Table	Nov., '23	25c
29.	Toy Tea Cart, etc.	Dec., '23	25c
30.	Tool Cabinet, etc.	Jan., '24	25c
31.	Sewing Cabinets	Feb., '24	25c
32.	Chinese Game Table	Mar., '24	25c
33.	Dining Alcove	Apr., '24	25c
34.	Garden Trellises	May, '24	25c
35.	Simple Radio Cabinet	Oct., '24	25c
36.	Rush-Bottom Chair	Nov., '24	25c
37.	Simplified Bookcase	Dec., '24	25c
38.	Sheraton Table	Jan., '25	25c
39.	Salem Chest	Feb., '25	25c
40.	Desk in Sheraton Style	Mar., '25	25c
41.	One-Tube Radio Set	May, '25	25c
42.	Three-Stage Amplifier	June, '25	25c
43.	Four-Tube Receiver	July, '25	25c
44.	Pirate Ship Model—Hull	Feb., '26	25c
45.	Pirate Ship—Details	Mar., '26	25c
46.	Galleon Model—Hull	May, '26	25c
47.	Galleon Model—Details	June, '26	25c
48.	Sailing Yacht Model	July, '26	25c
49.	Broom Cabinet	Aug., '26	25c
50.	Airplane Model (Flying)	Sept., '26	25c
51.	Clipper Ship Model—Hull	Oct., '26	25c
52.	Clipper Model—Details	Oct., '26	25c
53.	Clipper Model—Rigging	Nov., '26	25c
54.	Five-Tube Radio Set	Oct., '26	25c
55.	Five-Tube Set—Details	Oct., '26	25c
56.	Bird and Animal Toys	Dec., '26	25c
57.	Constitution Model—Hull	Jan., '27	25c
58.	Constitution—Rigging	Feb., '27	25c
59.	Constitution—Rigging	Mar., '27	25c
60.	Welsh Dresser	Mar., '27	25c
61.	Viking Ship Model—Hull	Apr., '27	25c
62.	Viking Ship—Details	Apr., '27	25c
63.	Toy Motor Boat—Hull	May, '27	25c
64.	Toy Motor Boat—Details	May, '27	25c
65.	Six Simple Block Puzzles	June, '27	25c
66.	Ship-Model Weather Vane	Aug., '27	25c
67.	Toy Model of Lindbergh's New York-to-Paris Plane	Aug., '27	25c
68.	Magazine-Rack Table and Book-Trough Table	Sept., '27	25c
69.	Flying Model (3 ft.) of Lindbergh's Monoplane	Oct., '27	25c
70.	Console Radio Cabinet	Nov., '27	25c
71.	Console Cabinet—Details	Nov., '27	25c

Name ..... (Please print name and address very clearly)

Street .....

City and State .....

Finally—the Perfect  
"A" Eliminator  
For Your Present Set or the Set  
you eventually buy



Our 4-volt "A" Eliminator  
Fits Into All Radiola Consoles

**Silver A Beauty POWER**

Replaces "A" storage battery and charger; has full wave "dry" rectification; maintains required voltage in uniform, constant flow; operates automatically by moving a switch; economical—uses minimum amount of current (about 1-10 cost of using electric iron); has rheostat control for additional refinement in voltage and reception; gives maximum power to radio tubes and lengthens their life; no acids to test or spill. Satisfactory results guaranteed.

*Its principle is simple and correct!*

The 110 volts Alternating Current is scientifically reduced with the famous "Silver Beauty" transformer coil to deliver the proper voltage to an especially developed dry, noiseless rectifier, which transforms the electricity to direct current. This current of exact voltage, is then transmitted through a patented special filter which clarifies the current, eliminating all foreign noises caused by rectifier or generator.

The "Silver Beauty" "A" Eliminator is endorsed by prominent radio engineers—adopted by leading distributors and dealers—approved by thousands of users. These are sufficient reasons for making *Silver Beauty* your choice.

**\$39.50 \$43.50 \$39.50**

6-volt; 2 amp. 6-volt; 3 amp. 4-volt; 1/2-amp.  
\$2 Higher West of Rockies

**Silver Beauty "B-C" UNIT**

Does away with "B" and "C" batteries

Embody every up-to-date refinement and principle, insuring smooth, unfailing reception. As beautiful as it is efficient.

No. 450  
180 Volts—40  
Milliamperes  
**\$45**

No. 460  
135 Volts  
**\$35**



Individual adjustment  
adapted to all sets.  
**Silver Beauty**  
CHARGERS

Employing an entirely new method of rectification. Two models  
—with or without bulbs.

See Your Dealer or Jobber

**Triple-A-Specialty Company**

Manufacturers of the famous Silver Beauty Chargers  
312-316 South Hamilton Ave., Chicago, Ill.

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# Installation FREE! On ANY Radio Set!

The Marvelous New Model



## Radio **AB** Socket Power

*Runs Any Radio from  
your Electric Current!*

Yes, any Authorized Philco Dealer will connect the wonderful Philco AB Socket Power to *your* radio set—*whether it is an old set or a new set*—at no extra cost to you. Installation is FREE!

**No Matter What Set You Own—  
No Matter What Set You Buy—  
Philco Will Run It From the Light Socket!**

*It makes no difference whether you now have a dry cell or storage battery operated set or what kind of battery radio set you buy, the Philco AB Socket Power will run it from the electric lighting current. Here is your chance to do away with the ordinary "A" storage battery and all dry cell "A" and "B" batteries. Super-power for all power tubes! No hum! No distortion! No more recharging to do! No more batteries to replace!*



*The Famous Philco AB  
Socket Power*

### Easy Payments!

You can buy the New Model Philco AB Socket Power from any Authorized Philco Dealer on Easy Payment Terms. Merely make a small first payment and pay the balance monthly.

### Trade In Your Old "A" Storage Battery

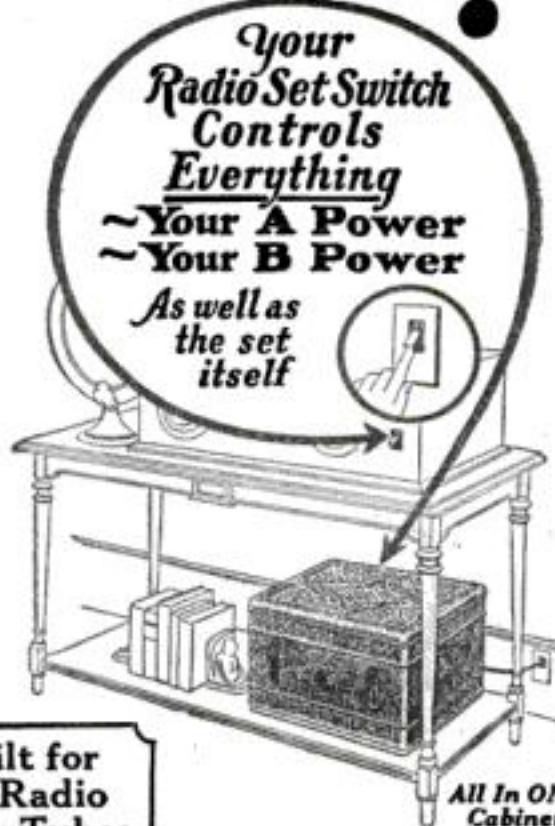
You won't need it with the Philco. Any Authorized Philco Dealer will make you a *liberal allowance* for your old "A" storage battery when you buy the brand-new Philco.

## Mail This Coupon NOW!

Just sign your name and address to this FREE Coupon, put it in an envelope and mail it to us. It does not put you under the slightest obligation. Then we will send you at once full descriptive literature on the New Model Philco AB Socket Power. We will also send you the full details of our liberal offer of Easy Payments, Free Installation and Trade-In Allowance.

**Philadelphia Storage Battery Co.**  
Ontario and C Streets  
Philadelphia, Pa.

© H. B. N.



Built for  
All Radio  
Power Tubes  
and  
Will Deliver  
**180 Volts**  
at 60 Milli-amperes

### Easy As Turning On Your Electric Light!

Merely snap ON your radio set switch when you want to listen in. Snap it OFF and your radio is silent. No fuss. No bother.

### Every Philco Guaranteed!

Each and every Philco AB Socket Power is covered by an ironclad factory guarantee and is built to conform to Underwriters' Laboratories Safety Specifications.

### Console-Cabinet Models

Console-Cabinet Models are built to fit *inside* the cabinets of practically all well-known radio sets, including:

Atwater Kent Freed-Eisemann Victrola-Radiola Pfanstiehl Fada Radiola-28 Brunswick-Radiola

Special Philco Units have been designed for Fada, Pfanstiehl, Freed-Eisemann, Stromberg-Carlson, Brunswick, Splittorf and Victor receivers and are tested and approved by these companies.

### Clip and Mail Today!



### Special FREE COUPON

To Philadelphia Storage Battery Co.  
Ontario and C Streets  
Philadelphia, Pa. Dept. 1088

I shall be pleased to receive your free illustrated literature describing the famous Philco Radio AB Socket Power; also the full details of your Easy Payment, Free Installation and Trade-In Allowance Offer.

Name \_\_\_\_\_  
Mail Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_



### GOOD TOOLS STOP WASTE

Tardy production means avoidable waste. Waste due to tool failures can be eliminated by using Simonds Saws, Machine Knives and Files.

**SIMONDS SAW AND STEEL COMPANY**

"The Saw Makers"

Fitchburg, Mass.

Established 1832

Branch Stores and Service Shops in Principal Cities

## VICTOREEN

Dependable Standardized Super Parts

Accepted as the Best in Radio

If you want the ultimate in radio reception—if you are one of those who demand range, clarity, volume and selectivity, then you will appreciate Victoreen supremacy in the super field! Victoreen has gained the confidence of those whose radio experience is based on scientific knowledge. They accept the new products of Victoreen, knowing that a progressive step has been made in Radio—one that has passed the experimental stage and arrived at the point of the utmost in satisfactory results.

#### Victoreen 112 Audio Transformer Unit

Designed to handle up to 400 volts of B battery supply, this unit is especially adapted to the Western Electric cone speaker or similar types. The transformer consists of two stages of Audio amplification in one case and is designed for use with two 112 power tubes.

Price \$22.00



Victoreen  
Radio Frequency  
Transformers  
No. 170—For Storage  
Battery Tubes.  
No. 171—For Dry  
Battery Tubes.

The very heart of the Super Circuit! These units are instruments of great precision, being matched and tuned to within one-third of one per cent and eliminating the necessity of tube marching.

Price \$7.00



Send today for 1928 Blue Print of Victoreen Circuit  
Makers also of the famous Victoreen Long  
Wave Super Coils, Master Control Units,  
Rheostats and Audio Control Units.



**The GEORGE W. WALKER Co.**  
MERCHANDISERS OF VICTOREEN RADIO PRODUCTS  
2825 CHESTER AVENUE CLEVELAND OHIO

### Paper Hanging

(Continued from page 89)



The seams can be rolled with an ordinary caster

to leave a long and disfiguring smudge. The hanging of the border comes last. It may be cut into any convenient lengths—not too long—for hanging. Paste, fold and trim; then hang the first piece by unfolding the right end and pasting it to the wall in the corner, lapping the end about 4 in. around the corner. If the ceiling is uneven, snap a chalk line across the wall as near the ceiling as possible and follow it with the border.

If the joints in the border come in a conspicuous place, or, indeed, if tears occur in any strip of the side wall or ceiling paper, they can be patched so as to be scarcely noticeable by feather-edging the joint. This is done by tearing in an irregular fashion the edges that are to lap the design and undertearing them so the edges will be thin and the stock only a fraction of its usual thickness. In this way the patch or joint practically melts into the design, and the edge is lost to the eye a foot or two away. The matching of the design must, of course, be consistent.

### Quick Ways to Mix Paste and Trim Wall Paper

TOO often the paste mixed by the amateur paper hanger is full of lumps or "kittens." I have known men to spend a half hour whipping the kittens out of a pail of paste. With an egg beater the same work could have been done much better in less than two minutes. The egg beater quickly reduces the paste to a soft consistency like oil or paint. This saves time, material and labor.

For trimming the paper, I have found a safety razor blade to be excellent. Paste a piece of building felt on a wide board 3 ft. long. Unroll about 2 ft. of paper on the board. Reach forward, place the blade on the trimming line and draw it towards you. Bring the roll forward, let the trimmed paper fall over the edge of the table, unroll another 2 ft. and go through the same process, continuing to the end of the roll. A little practice enables one to draw the blade rapidly and make a perfectly straight trim. Trimming a roll or more at once saves time.

Hanging paper on the ceiling has its difficulties, but a contrivance can be made to take the place of experience. Nail a narrow board on each side of a stepladder so that it reaches within about 2 in. of the ceiling. Put (Continued on page 106)

# THE THINGS YOU WANT WITH THE KIND OF TOOLS YOU MOST DESIRE

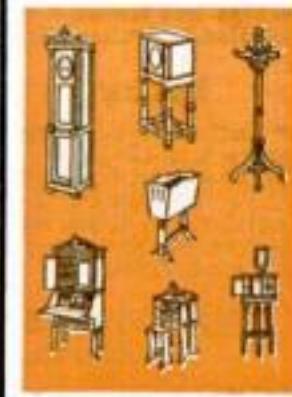


The desire to make the things we want is every man's ambition. It is a known fact that real tools are necessary for this accomplishment. Often you have been handicapped in your work because of the lack of tools. Previous to this time the average man could not afford equipment including lathes, saws and all other necessary motor driven tools. Now upon the introduction of the Up-to-Date Home Craftsman Shop it is possible with only \$10.00 down to avail

yourself of a real machine shop complete in every mechanical detail.

Furniture, toys, home necessities, parts for your automobile, radio parts and cabinets and every article in which mechanics are interested can now be turned out with the ease and speed of a professional workshop.

Further information and details of this shop may be had by mailing the corner coupon.



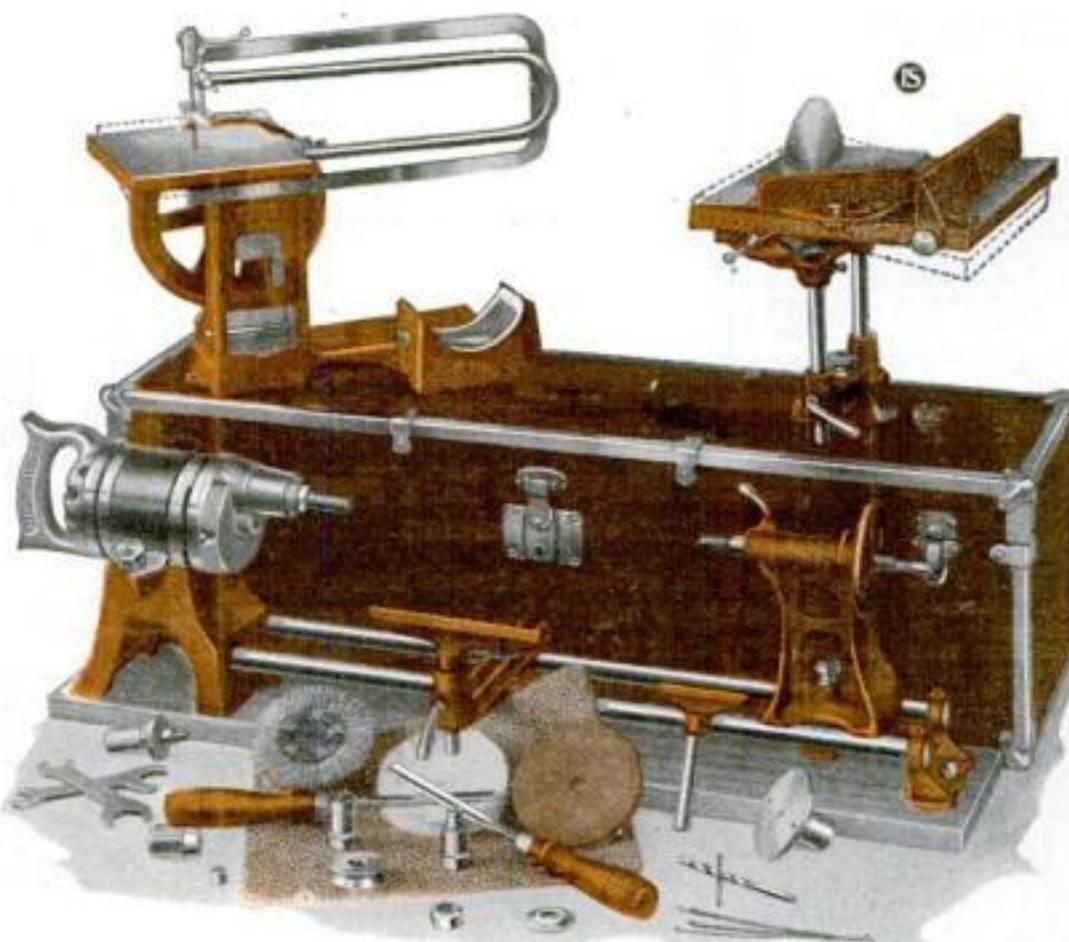
## HOME MECHANICS MADE EASY WITH THE NEW UP-TO-DATE HOME-CRAFTSMAN SHOP

**ONLY  
\$10  
DOWN**

*Your Own Terms  
on Purchase  
\$10.00 Down—  
Balance Arranged  
to Your  
Convenience  
Liberal Discount  
for Cash*

### Guarantee

After receipt of the Up-to-Date Home Craftsman Shop if you are not satisfied, without question or delay every cent refunded and return express charges paid.



**SENT  
ON  
TRIAL**

*Our Literature  
Gives All  
Details and  
Information*

### Our Educational Department

Under Personal Supervision of Master Craftsman Eugene E. Maurey offers special correspondence crafts course giving in simple detail full information on home handicraft. Blueprint service included in this course FREE to our users.

The Up-to-Date electrical Home Craftsman Shop can be used in any home lighting fixture thus making of your old fashioned work bench a complete machine shop. The shop complete is made up of a Superpower motor, an accurate lathe (10x34 inches) which features the bevel, a miter, side and depth gauges, a superior tilting table, jigsaw, and all accessories for buffing, grinding, cleaning and all portable or stationary drilling and

sawing. This collection of electrically driven tools which is complete in every detail, will make you an advanced craftsman. Master mechanics have designed and skilled engineers have constructed this equipment which after inspection, you will agree is the best of its kind. For those who build, invent, create and construct at home, it is unexcelled.

### 15" Band Saw

Accessory  
to Up-to-  
Date Shop



### CAREFULLY DESIGNED BLUE PRINTS FREE TO SHOP OWNERS

Working blueprints of furniture and other items which are useful about the home and shop. Hundreds free to shop owners.

### 4" Jointer Model A-1928 Accessory to Up- to-Date Shop



**NOT A  
TOY,  
A REAL  
MACHINE**

**10 DAY FREE TRIAL**

Use our shop for 10 days at our expense, if not satisfied—Return—express collect.

### MAIL THIS

For Full Particulars to  
**UP-TO-DATE MACHINE WORKS**

2915 South Wabash Ave., Chicago, Ill.  
MANAGER, Dept. A:—Without any obligation please send me full particulars about your shop, 10 day free trial, free blue prints, free crafts course. Also \$10.00 down payment offer.

NAME.....

ADDRESS.....

# This Marvelous Tool! Pays 1000 a Month

No other wrench like it.

## The First and Only "One Hand" Monkey Wrench

No Thumb Screw Adjustment—That simple slide motion locks securely with a hold that resists over 750 pounds end pressure. Compare this with any other wrench. Does away with the old thumb screw idea that was always a handicap. In every sense a "One Hand Monkey Wrench."

### Mechanics Wild Over It

Any mechanic readily appreciates the greater convenience and efficiency of the H&E Wrench and wherever shown they are anxious to own one. As one mechanic puts it, "I don't see how I ever could do without the H&E Wrench." That simple slide motion gets their eye and it locks with a better grip and releases instantly.

### Slides Up and Down—Locks Automatically

The H&E Wrench creates a sensation wherever shown. Its simplicity, smooth action, strong grip and practical value arouses interest everywhere: In the Factory, Machine Shop, Garage, on the Farm, or in the Home; in fact, wherever tools are used—they all go wild over it.

### Praised by Big Concerns

The C. I. & Q. Railroad and many other large Corporations have acknowledged its value and endorsed it. Automobile Owners want it for convenience and our Agents tell us "It is the easiest selling article they ever tackled."

### 500 Agents Wanted at Once

Rapid sales with a handsome profit make this a very attractive proposition for Agents and on account of this unusual demand we want agents everywhere and the opportunity is open to you NOW but you must ACT PROMPTLY.

### This Is Your Opportunity

Think of the big sales possibilities right in your locality and surrounding territory—even if you never sold anything in your life before, we show you how to be successful: In fact, under our plan you even get your H&E Wrench FREE.

MAIL  
TODAY



GET YOURS FREE

### H&E WRENCH SALES CORP.

Dept. K, 228 No. LaSalle St., Chicago, Ill.  
Dept. K, 285 East 134th St., New York City

H&E WRENCH SALES CORP.,  
Dept. K, 228 No. La Salle St., Chicago, Ill.  
Dept. K, 285 East 134th St., New York City.

Gentlemen:—  
Please mail me FREE particulars. This does not obligate me in any way.

Please mail C.O.D. one H&E Wrench.

NAME.....

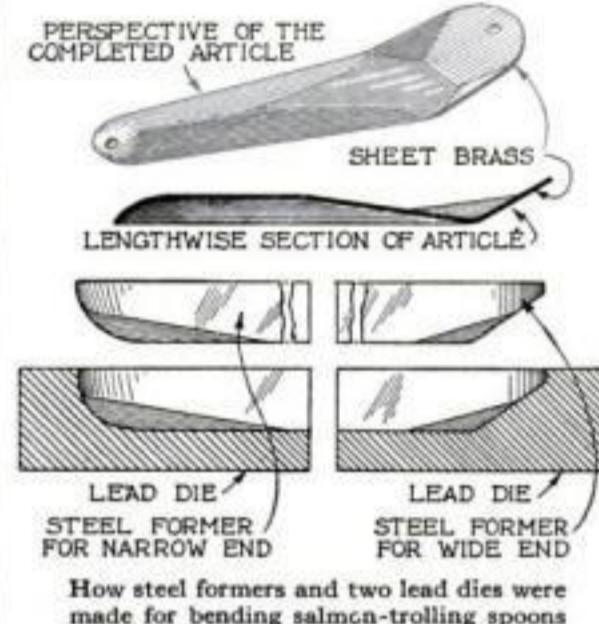
ADDRESS.....

TOWN..... STATE.....

### Small Bending Dies for Sheet Metal Parts

TO MAKE some salmon-trolling spoons of my own design, I required a bending die. This I made by grinding a piece of key steel of convenient length to the desired shape at each end and then pouring lead over it to make a separate die for each end of the spoon, as illustrated. After cutting sheet brass to the proper shape, I placed the large end in the die for forming that end and struck the steel punch with a hammer. The other end was bent in the other die in the same way.

I found it was possible to make the spoons at the rate of about two a minute. I formed about 100 and could probably have made 1,000 or more. Dies of this kind could be used for other purposes.—CHARLES J. RAMSEY.



### Quick Ways to Mix Paste

(Continued from page 104)

a piece 1 in. square on top of these, leaving the upper edge 1 in. from the ceiling. Cut the paper to length and paste it; then fold each end over, and hang the folded strip over the top of the support on the ladder. Unfold one end and begin to put it on the ceiling.

This device is especially helpful when building felt and other wide papers are used. It carries the weight of paper and holds it straight, while the workman is left to use his mechanical skill on a small portion at a time.—WALTER S. DE WITT.

### Hints on Paper Hanging

BY ADDING half a tumbler of molasses to half a bucket of paste, the amateur decorator can avoid some of the difficulties which are apt to arise in hanging paper on the ceiling. This mixture is a tacky coating that adheres more readily than a plain paste.

I have found that the best results are obtained by pasting only one strip of paper at a time, if it is of the ordinary type, and putting it on the ceiling before it becomes too soggy by long soaking, which is apt to be the case if two strips are pasted at once. On the other hand, if a varnished paper is used, as in a kitchen or bathroom, it is better to paste the two strips at once to allow longer for penetration.—ALBERT L. SNEDAKER.

# fix it yourself all you need is heat



If a household utensil goes wrong—Solder it!



If a part of a car or tractor goes wrong—Solder it!



If you have electrical wiring to do—Solder it!

It's a regular hobby with thousands of people—to fix things themselves. And now, with Kester Metal Mender men, women and boys actually solder!

You too, can use Kester Metal Mender expertly right in your own home. Kester requires only heat, is easy to use, and it's a genuine solder, too! It carries a scientific flux inside itself. Like the lead in a pencil, this flux does the work.

Think of how many useful things you could put back into service with just a touch of Kester, here and there.

Buy a can today from your hardware dealer, general store, auto supply shop or druggist. If you want to be convinced without expense—write for Free Sample.



## KESTER METAL MENDER

The Household Solder

CHICAGO SOLDER COMPANY  
4211-09 Wrightwood Ave., Chicago, U.S.A.  
Established 1899

## FREE The Greatest RADIO CATALOG

Send for  
This Great Book

Compiled exclusively for dealers in radio sets, radio parts, and for set builders. An Amazing Catalog containing the newest things in the world of radio.

Unbeatable values in Radio Parts, Kits and Supplies of National Fame. A complete array of cabinets and consoles, in all latest styles, finishes and popular sizes, at Unmatched Prices.

The high quality of our products eliminates loss. Large stocks offer you large selection. Our speedy shipments insure your customers' good will and bigger profits for you.

Wholesale Vest Pocket Price List and Discount Sheet

This wholesale vest pocket price list and discount sheet will be sent with the catalog.

### SHORT WAVE SECTION

Our catalog contains a section devoted to a showing of the highest grade short wave receiving and transmitting apparatus. Also the finest electrical appliances for use in the home.

Shure Service means sure profits. You can take orders direct from our illustrated list price catalog.

Whatever your radio needs may be, you will find them in our 1928 catalog. Write for a copy TODAY.

**SHURE RADIO COMPANY**  
339 West Madison Street, Chicago, Ill.



# Just 15 Minutes a Day

What it will mean to you is told in the FREE BOOKLET below

HERE are two men of equal position and business income. Which of them represents you?

They read about the same number of hours each week. But one has no plan for his reading; at the end of the year he has little or nothing to show.

The other talks like a man who has traveled widely, though he has never been outside of the United States.

He knows something of science, though he had to stop school at fifteen. He is at home with history, and the best biographies, and the really great dramas and essays. Older men like to talk to him because he has somehow gained the rare gift of thinking clearly and talking interestingly.

What's the secret of his mental growth? How can a man in a few minutes of pleasant reading each day gain so much?

Dr. Charles W.



Eliot, from his lifetime of reading, study, and teaching, forty years of it as President of Harvard University, answered that question in a free booklet that you can have for the asking.

"For me," wrote one man who had sent in the coupon, "your little free book meant a big step forward, and it showed me, besides, the way to a vast new world of pleasure." This free booklet describes the contents, plan and purpose of

## Dr. Eliot's Five-Foot Shelf of Books

Every well-informed man and woman should at least know something about this famous library.

The free booklet tells about it—how Dr. Eliot put into his Five-Foot Shelf "the essentials of a liberal education," how he so arranged it that even "fifteen minutes a

day" are enough, how in pleasant moments of spare time, by using the reading courses Dr. Eliot provided for you, you can get the knowledge of literature and life, the culture, the broad viewpoint that every university strives to give.

Every reader of this magazine is invited to have a copy of this entertaining book. It is free, will be sent by mail, and involves no obligation of any sort. Merely clip the coupon and mail it to-day.

**The Free Booklet gives  
Dr. Eliot's own plan  
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**P. F. COLLIER & SON COMPANY  
250 Park Avenue, New York City**

By mail, free, send me the booklet that tells all about the most famous library in the world, describing Dr. Eliot's Five-Foot Shelf of Books (The Harvard Classics), and containing the plan of reading recommended by Dr. Eliot. Also, please advise how I may secure the books by small monthly payments.

Name *Mr. \_\_\_\_\_  
Mrs. \_\_\_\_\_  
Miss \_\_\_\_\_*

Address \_\_\_\_\_

5276-HCC-L

The publishers cannot undertake to send the booklet free to children

Radio • Is • BETTER • With • Dry • Battery • Power



## You can candle an egg—but not a battery



HERE isn't much difference in the size or shape of batteries. And you can't tell how good they are before you use them. If you could, one element alone would win your preference for Burgess. That element is *Chrome*. *Chrome* is the preservative that maintains an abundance of unfailing energy in Burgess Batteries—long after most dry cells cease to function. The black and white stripes are individual marks for identifying Burgess *Chrome* Batteries. Buy them for long lasting, dependable performance!

**Chrome**—the preserving element used in leather, metals, paints and other materials subject to wear, is also used in Burgess Batteries. It gives them unusual staying power. Burgess *Chrome* Batteries are patented.

Ask Any Radio Engineer

**BURGESS BATTERY COMPANY**

General Sales Office: CHICAGO

Canadian Factories and Offices:  
Niagara Falls and Winnipeg



## BURGESS FLASHLIGHT & RADIO BATTERIES

 This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

## Simple Power Amplifier

(Continued from page 76)

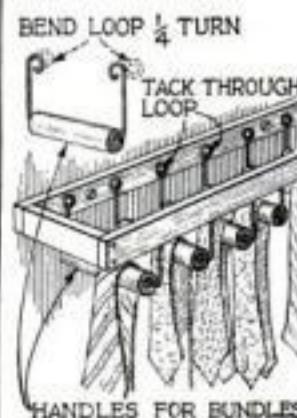
any changes or adjustments while the eliminator is in operation. This does not apply, of course, to making changes in the variable resistances by means of the knobs provided for that purpose.

You can handle the wiring of the receiver or the loudspeaker with no more chance for shock than you would take with ordinary B-batteries, because the high voltage used to operate the 210 tube is confined within the power amplifier unit.

Before you first put the power amplifier unit into operation make sure that all three tubes are inserted in the sockets so that the tube prongs make firm contact with the springs and set the movable contact finger of resistance F about midway between the two ends. Set resistance G so that the full 2000 ohms are in the circuit. After you have the outfit in operation adjust the contact on resistance F one way or the other until the signals are as loud and clear as possible. Then gradually move the contact finger of resistance G so as to cut out part of the resistance in the circuit. The volume and tone will immediately begin to improve. Continue moving the contact until the signals are as loud and clear as possible, but always keep as much resistance as you can in use in order to prolong the life of both amplifier and rectifier tubes. If you should turn the knob of resistance G so as to make the value of the resistance remaining in the circuit too low, the amplifier tube will be seriously overloaded. In most cases about half the resistance, or 1000 ohms, will be found about right. Never operate the power amplifier unit without a voltage regulator tube in socket J.

A special list of parts approved by the Popular Science Institute of Standards for use in building this power amplifier unit has been made up and you can obtain one by addressing your letter to: Radio Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City. If any points about the construction or operation of the power amplifier unit are not clear to you include your questions in your letter. Please make your questions as specific as possible.

### A Roller Rack for Ties



How handles are assembled in a frame

with large tacks. A coat of stain or lacquer improves the appearance of the rack.—L. A. LANGREICH.



## “How I Licked Wretched Old Age at 63”

**“I Quit Getting up Nights—Banished Foot and Leg Pains . . . Got Rid of Rheumatic Pains and Constipation . . . Improved Embarrassing Health Faults . . . Found Renewed Vitality.”**

“At 61, I thought I was through. I blamed old age, but it never occurred to me to actually fight back. I was only half-living, getting up nights . . . embarrassed in my own home . . . constipated . . . constantly tormented by aches and pains. At 62 my condition became almost intolerable. I had about given up hope when a doctor recommended your treatment. Then at 63, it seemed that I shook off 20 years almost overnight.”

### Forty—The Danger Age

These are the facts, just as I learned them. In 65% of all men, the vital prostate gland slows up soon after 40. No pain is experienced, but as this distressing condition continues, sciatica, backache, severe bladder weakness, constipation, etc., often develop.

### Prostate Trouble

These are frequently the signs of prostate trouble. Now thousands suffer these handicaps needlessly! For a prominent American Scientist after seven years of research, discovered a new, safe way to stimulate the prostate gland to normal health and activity in many cases. This new hygiene is worthy to be called a notable achievement of the age.

### A National Institution for Men Past 40

Its success has been startling, its growth rapid. This new hygiene is rapidly gaining in national prominence. The institution in Steubenville has now reached large proportions. Scores and even hundreds of letters pour in every day, and in many cases reported results have been little short of amazing. In case after case, men have reported that they have felt ten years younger in six days. Now physicians in every part of the country are using and recommending this treatment.

Quick as is the response to this new hygiene, it is actually a pleasant, natural relaxation, involving no drugs, medicine, or electric rays whatever. The scientist explains this discovery and tells why many men are old at forty in a new book now sent free, in 24-page, illustrated form. Send for it. Every man past forty should know the true meaning of those frank facts. No cost or obligation is incurred. But act at once before this free edition is exhausted. Simply fill in your name below, tear off and mail.

**The Electro Thermal Company**  
4075 Main Street Steubenville, Ohio



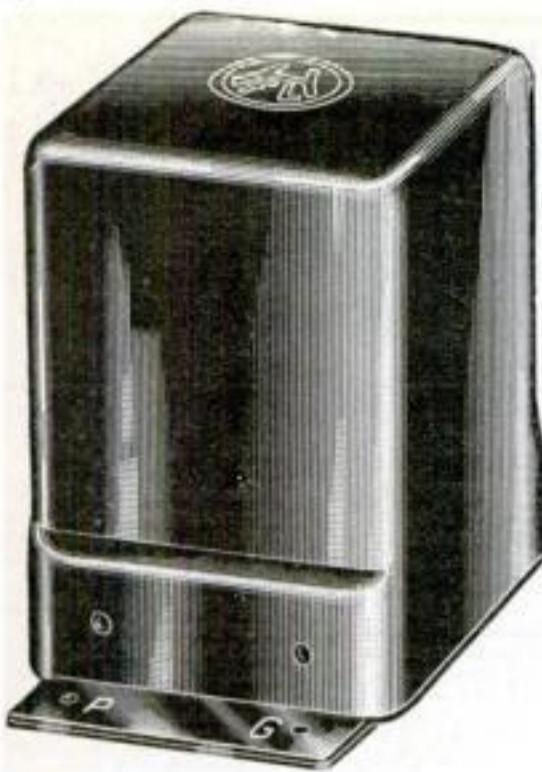
**THE ELECTRO THERMAL CO.,**  
4075 Main Street, Steubenville, Ohio.

Name . . . . .

Address . . . . .

City . . . . . State . . . . .

Western address: Suite 40-U, 303 Van Nuys Bldg., Los Angeles, Cal.



## H·F·L. Transformers

H.F.L. C-16 Audio Transformers  
and C-25 Output Transformer—  
New Companions of a Great Circuit

Engineers acclaim H.F.L. C-16 a marvelously efficient Audio Transformer. It carries signals at highest volume and lowest amplitude without blasting or developing harmonics. Operates with all power tubes as well as standard tubes.

H.F.L. C-25 Output Transformer handles the voltage output of power amplifying tubes, at the same time matches the impedance of the average speaker to the tubes. Protects loud speaker unit without reducing plate voltage.

Mechanical features of these two transformers are: A coil designed and treated to exclude moisture and withstand heavy electrical surges without breaking down—complete magnetic shielding to avoid interstage coupling—terminals brought out so as to insure short leads.

Endorsed by America's Leading Engineers—  
Guaranteed by the Manufacturers

The new C-16 and C-25  
Transformers will  
work in any  
circuit and will  
improve any  
Radio  
Set.



### Set Builders and Dealers

If your jobber cannot supply you with H.F.L. Transformers, write us for name of nearest jobber.

High Frequency  
Laboratories  
133-M NORTH WELLS STREET  
CHICAGO, ILL.

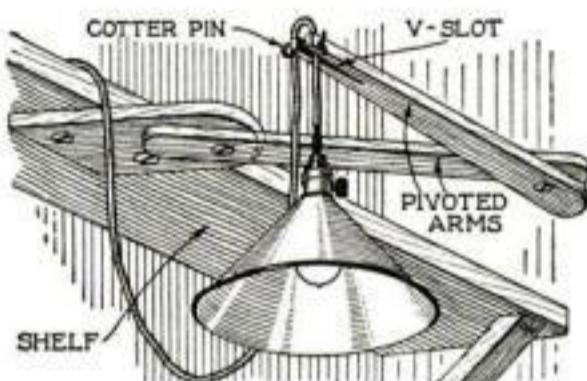


PRICES	
H-210 Tran.	\$8.00
H-215 Tran.	8.00
C-16 Transf.	8.00
L-425 R. F. Choke.....	5.50
L-430 R. F. Transform.	5.50
C-25 Output Transform.	8.00

### How to Make Adjustable Arms for Shop Lights

A VERY simple swinging arm for an adjustable shop or bench light is illustrated. I made it to hang over my engine lathe, and it worked so well that I am equipping my entire shop with similar arms.

It is possible to swing the light in a wide arc about the work and also to adjust the light at different heights by



A bench light which can be moved freely within the limits of its supporting arms

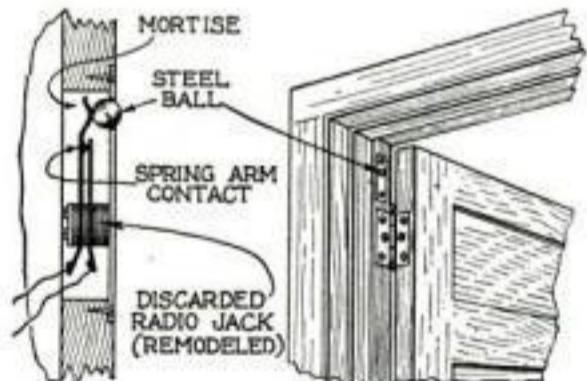
pushing the wire firmly in the V-shaped cut in the end of the outer arm. The whole affair may be made in a very short time from scrap lumber, the dimensions of which are not particularly important. The broad piece fastened to the shelf or ceiling can be  $\frac{3}{4}$  in. thick and 4 in. wide and the arms  $\frac{3}{4}$  by  $1\frac{1}{2}$  in.

Two of these arms over the workbench allow the light to be adjusted just where you want it to avoid shadows; also, two of the arms over the drafting table are convenient for night work.—E. T.

### Door or Window Alarm Switch Made from Radio Jack

FROM a discarded radio jack, it is possible to make an efficient spring switch for ringing a bell or buzzer at a distant point when a door or window is opened.

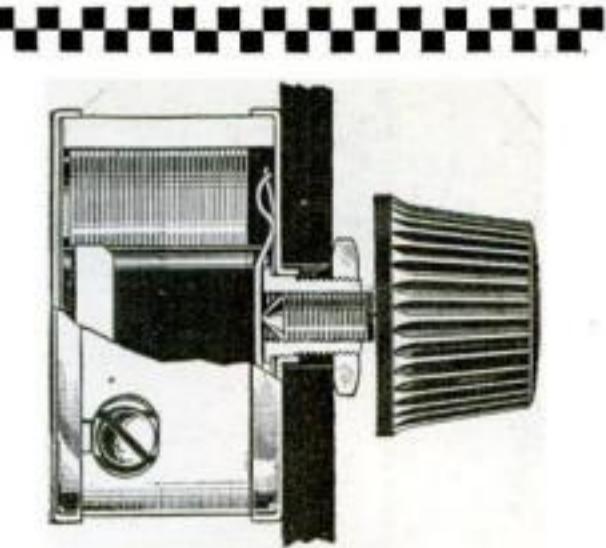
The standard base is removed from the jack and in its place one that is straight



Cross section of the homemade alarm switch and where it is placed in the jamb

and flat is attached, as illustrated. A steel ball taken from an old ball bearing is set in such a way as to project through a hole in the base of the jack when the door is in an open position. When the door is closed, the ball is forced in, breaking the contact.

As the jack is small and compact, only a shallow mortise is necessary. If reasonable care is taken in installing and painting the device, it will almost defy detection.—J. C. ISHAM.



### Bradleyohm-E PERFECT VARIABLE RESISTOR

The graphite disc principle, utilized in the construction of Bradleyohm-E assures noiseless, stepless regulation of plate voltage when used in B-Eliminator hookups.

By turning the bakelite knob, the plate voltage output of the B-Eliminator can be adjusted, without steps or jumps, to the precise value for maximum volume. That is why prominent B-Eliminator manufacturers have adopted Bradleyohm-E.

Ask your dealer for Bradleyohm-E in the distinctive checkered carton.



### Bradleyunit-A

#### PERFECT FIXED RESISTOR

This is a solid, molded fixed resistor that does not depend upon hermetic sealing for accuracy. It is not affected by temperature or moisture and can be soldered without disturbing its rating.

For resistance-coupling, grid leaks, and other applications, ask your dealer for Bradleyunit-A in any desired rating.

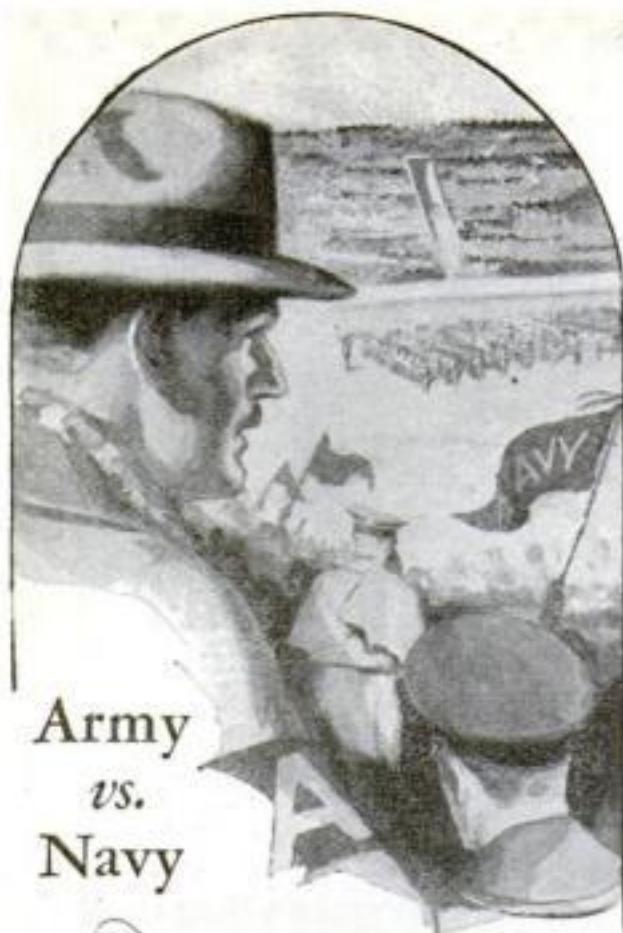
### Allen-Bradley Co.

#### ELECTRIC CONTROLLING APPARATUS

293 Greenfield Ave.



Milwaukee, Wis.



Army  
vs.  
Navy



## New Model Pocket Ben

Nearly a hundred thousand people will flock to the great Army-Navy football game this month.

Many thousands of them carry the New Model Pocket Ben.

That's because it combines good looks with reliable time-keeping.

Pocket Ben—made by the makers of Big Ben and other Westclox—is sold everywhere for \$1.50. With night-and-day dial \$2.25.

WESTERN CLOCK COMPANY  
La Salle, Illinois

## What You Can Make with Wallboard

By GEORGE W. ROYER

ONE of the most useful materials for the handy man to have in his home workshop is wallboard. I find many uses for both hard-finished fiber wallboard and the thick sugar-cane type of board. Either can be used for drawer bottoms, picture frame backs and as panels for doors, sides of cupboards, wardrobes and chests.

Recently I built a clothes closet in a corner of an upstairs room with wallboard and some  $1\frac{1}{8}$  by 2 in.,  $1\frac{1}{8}$  by 3 in., and

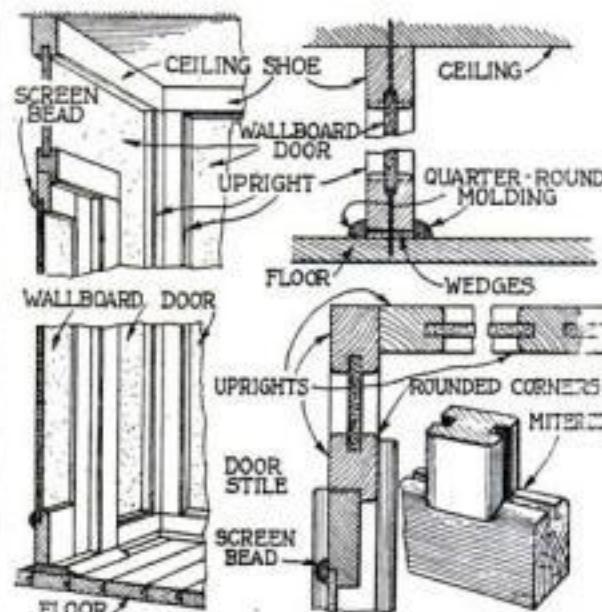


Fig. 1. Cutaway view of the inside corner of a clothes closet; details of construction

$1\frac{1}{8}$  by 5 in. pieces of wood and  $\frac{5}{8}$ -in. quarter-round moldings.

The method, which is illustrated in Fig. 1, is a quick, cheap and easy way to build a light partition for any purpose. Both sides are alike and present a neat appearance with a minimum of material and labor. While it is, of course, not intended to be "bull strong," yet the stiffness of this construction is surprising.

With a sheet or two of wallboard and a quantity of  $\frac{3}{4}$  by  $1\frac{3}{4}$  in. white pine, ploughed as shown in Fig. 2, the home carpenter can make any ordinary panel. The pieces for the frame are cut to the required lengths and mitered or doweled together at the corners. A sheet of wallboard is slipped in before the last piece is bradded or doweled in place. By making the panels a standard width of 16 in., either 32-in. or 48-in. wallboard can be used without waste.

When lacquered, painted or grained, these panels present a neat appearance.

Two of our Home Workshop blueprints show pieces of furniture made with wallboard panels such as Mr. Royer describes. They are Blueprints No. 20, Flat Top Desk, and No. 22, Girl's Cabinet, Writing Desk and Book Rack (see page 102). Because of their method of construction, both of these pieces can be made at very little cost.



## Tonight's the Night

TONIGHT'S the night for practice at Dick's house. Don't miss it, for practice makes perfect. Soon you'll want to join a high school or college band and get all the fun and profit, too, that's in it.

But, don't let the "wiseacres" tell you that you can learn to play on any cheap instrument. If you want to become a really good musician begin by buying the best—a King Band Instrument. You'll learn quicker and play better. That's the truth!

King Band Instruments, the finest made, cost no more than other makes. And they're sold on easy monthly payments. Write for interesting booklets, "Tootin' My Own Horn" and "Handy Reference Catalog". Both sent free.

**KING** THE H. N. WHITE CO.  
5237-93 Superior Ave., Cleveland, O.

Please send me free copy of "Tootin' My Own Horn" and your "Handy Reference Catalog". (Check, below, the instrument preferred.)

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

Saxophone  Trumpet  Trombone  Alto  
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get this genuine leather 5-window pass case. Holds Railroad Passes, Auto License, Lodge Cards, etc. Masonic or Shrine Emblem stamped on in gold free. Your name or other stamping 35¢ extra per line.

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1 Carat Elite Diamonds. Matchless for their dazzling rainbow brilliancy. You'll be delighted. Elite Rings Surpass all others. Stand acid and other tests. Handsomely Engraved Ring sterling guaranteed. Looks like \$250.00. Proud owner offered \$85.00 5 minutes after buying one. Collar and Cuff Links FREE. With each ring order, we give free beautiful Combination Set set with small Elite Diamonds. SEND NO MONEY. Just send name, address and finger size. On arrival pay postage \$3.89 and postage. Satisfaction Guaranteed. Write today. Cash with Canadian or foreign orders.

Elite Jewelry House, Dept. 381, 609 S. Paulina St., Chicago, Ill.

## Two Free Books

Breed squabs and make money. Sold by millions at higher prices than chickens. Write at once for two free books telling how to do it. One is 40 pages printed in colors, other 32 pages. Ask for Books 3 and 4. You will be surprised. Plymouth Rock Squab Company, 616 H Street, Melrose Highlands, Massachusetts.

## The Electrician's Wiring Manual

By F. E. SENGSTOCK, E. E.

Contains all the information needed for the proper installation of lighting and power systems in houses and other buildings.

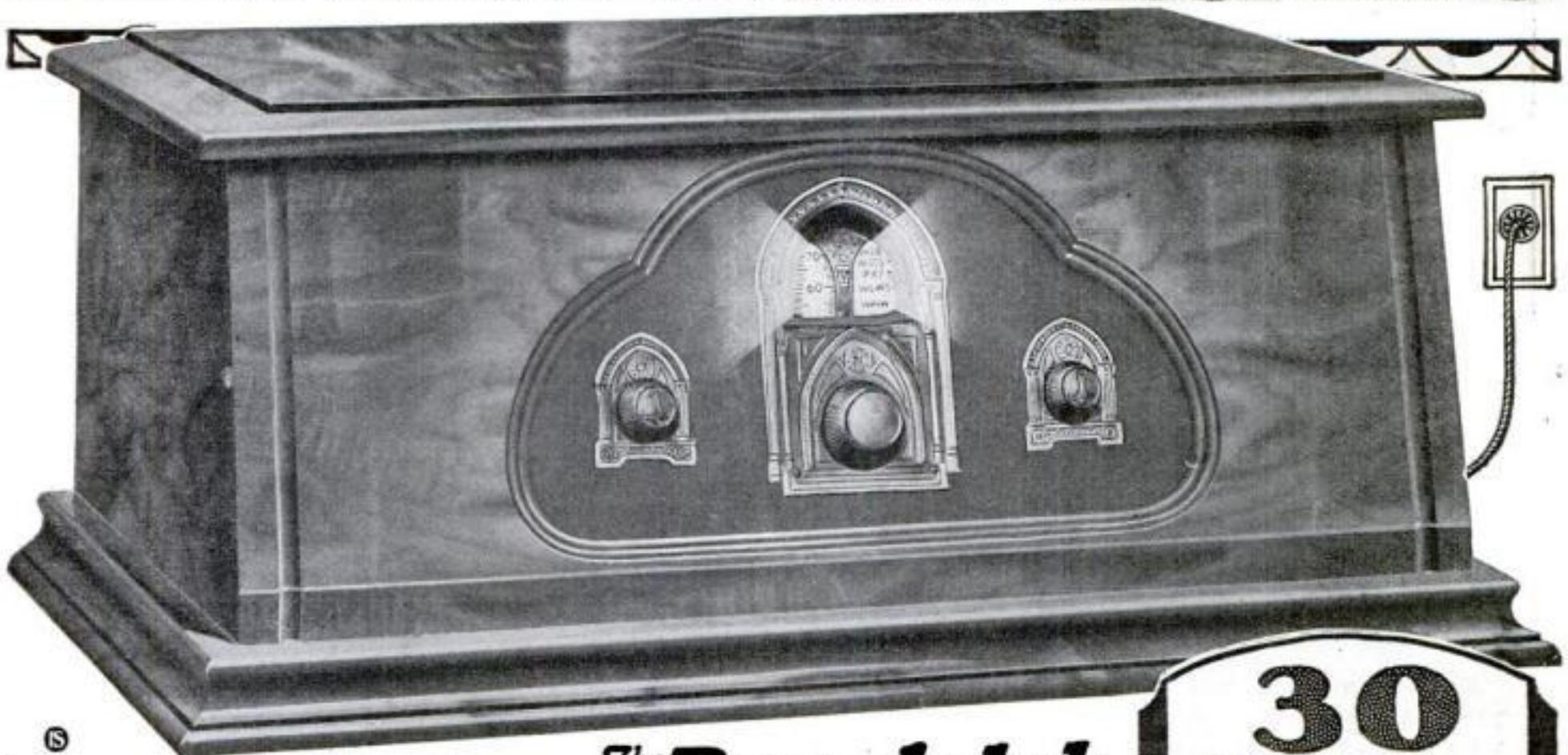
It completely covers inside electrical wiring and construction in accordance with the National Electric Code.

*Pocket size—flexible binding*

448 pp.

Price, \$2.50

# All Electric Radio



## 7 Tubes-Single Control

JUST plug this Randolph Radio into the electric light socket—and tune in. A powerful, selective radio that gives dependable

unlimited reception. **No Batteries, chargers, eliminators, acids or liquids.** Here is complete radio satisfaction whenever you want it. The easy tuning with one control brings on all stations. Illuminated drum allows you to operate the radio in the dark and has space for logging stations. Every detail of the Randolph is modern and perfected—it is the master-built radio the wonder set of the day. It is this wonderful radio that you test and try for 30 days FREE before you buy. Listen to it in your own home. When it convinces you by actual performance it is the ideal radio—the one you have always hoped for—you can buy it direct at factory prices. Be sure you write for free descriptive literature today.

### Beautiful Ampliphonic Console



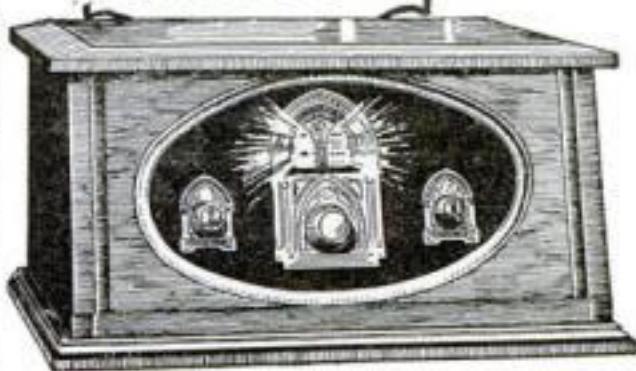
Illustrated here is one of the beautiful Randolph Seven Console Model—made of the finest carefully selected heavy solid walnut, hand-rubbed and with burl finish. Has built-in genuine large Amplian cone speaker of the finest quality. Assures unlimited reception of high notes and low notes clear as a bell. Completely electric—uses no batteries of any kind. Be sure you send for fully illustrated, full color folder giving complete details.

**Genuine Walnut Cabinets**  
The finest of heavy, genuine, solid burl finish walnut is used in the making of all Randolph cabinets. No picture can do them justice. You must see them to appreciate them.

### 6-Tube Radio

New, modern, single-control, six-tube radio. Do not compare this set with old-style, 2-dial, 6-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers. Comes in beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated drum with space for logging. Absolutely dependable and very selective. **Send for 30 days free trial. You test it before you buy.**

**All Sets  
Guaranteed**



**30  
DAYS  
FREE  
TRIAL**

**6  
Tube  
\$55  
Retail  
Price**

**Biggest  
Discounts  
To  
Agents**

**USE THIS COUPON TODAY!**

**Randolph Radio Corporation  
711 West Lake Street, Dept. 251  
Chicago, Illinois**

Send me full particulars about the RANDOLPH Six and Seven-Tube Electric and Battery Table and Console Sets with details of your **30 Day FREE Trial Offer.**

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

Mark here  if interested in Agent's proposition.

**RANDOLPH RADIO CORPORATION  
711 West Lake Street Dept. 251 Chicago, Ill.**

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

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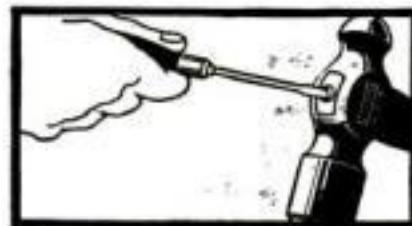


## This new invention is important to you

**HEAVY BLOWS...** on metal—they soon loosen the securest head.

But with a Plumb Ball Pein you need never work with a wobbly head. When steady pounding and shrinkage loosen a Plumb Handle, you just turn the screw wedge, and the head is tight again.

The greatest tool invention in years! It eliminates loose handles for all time by giving you a way instantly to retighten them.



When steady pounding and shrinkage loosen a Plumb Handle you just turn the Screw Wedge and it is tight again

A Plumb is built for hard work. Head is mounted off-center to add power to your blows. Oblong eye takes a sturdy, full-size handle. Pein is cone-shaped to spread instead of mash rivets. Handle is of selected hickory, double tested.

A safe hammer for your car or work bench, the Plumb Ball Pein. At all hardware stores. Look for the Red Handle and Black Head. Number H F 375, 1½ lb., costs \$1.30. Other sizes in proportion.

FAYETTE R. PLUMB, Inc.  
Philadelphia, U. S. A.



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# System in Surface Grinding

*How to Save Your Time and Insure Accuracy in Setting Up Special Work—Three Typical Jobs*

By HECTOR J. CHAMBERLAND

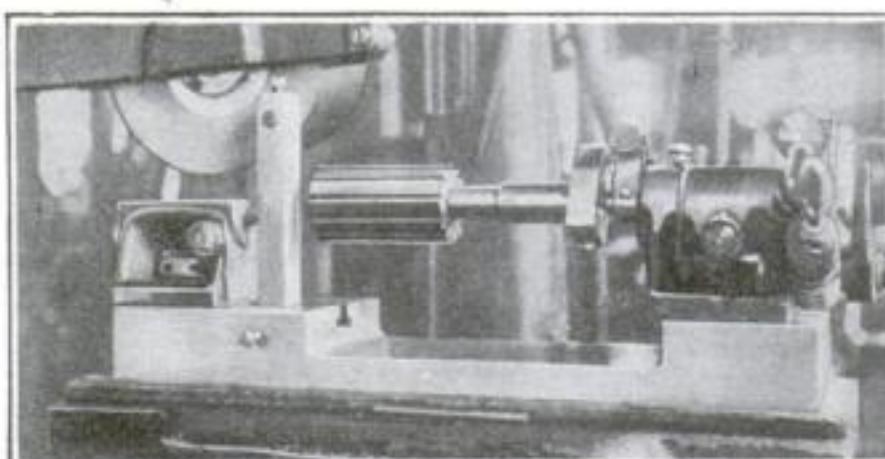


Fig. 1. Set-up for sharpening a special cutter. Note the wheel dressing arrangement and the plate for holding the index centers

**A**SIDE from the ordinary uses of the surface grinder with which toolmakers and machinists are familiar, this adaptable machine may be called into service for operations outside its regular line of work. An example is illustrated in Fig. 1—the sharpening of a formed cutter for knurling tools.

The set-up shown is as quick as any and the results are very accurate. A 60-H wheel of the bevel-and-concave type is used. As the mill is a straight flute cutter, the grinding is done on the concave side. A diamond is mounted on the plate as shown and set radially with respect to the indexing center. Every time the wheel is dressed, it automatically sets itself radially.

When dressed, the wheel is stopped and the first tooth of the mill is lined up with the cutting side after the dog has been released from the mandrel. The cutter is moved away from the wheel with the traverse feed, and rotated an amount equal to what is to be removed for sharpening. The point of the tooth is in an undercut position. The dog is tightened, the cross-feed is worked away from the wheel, and the tooth is ground until the diamond touches the wheel. The tooth is now radial again, and the cutter is indexed for the next tooth and the operation repeated.

This method gives the same results as an expensive machine or fixture. As the wheel is dressed before grinding each tooth, a good finish is left and an accurate job done in respect to the teeth being radial and equidistant.

Ordinarily tools of the same type as the square punch illustrated in Fig. 2 are ground on an angle plate, but the toolmaker's block shown in Fig. 5

saves time in this work and will soon pay the initial cost. It is intended to be used in connection with bench- or filing-lathe spring chucks, but can be made to suit one's individual needs.

The hole is ground and all sides are finished square with the hole. The four sides parallel to the hole are exact and an equal distance from the center of the hole.

After the shank of the punch or gage is ground, the tool is lined up in the block, the square is ground in relation to the shank, and a small amount of stock is taken off each side by turning the block over without changing the downward feed; then the same amount is ground off each side to attain the correct dimensions. The block is then turned upright and the end of the tool squared.

The block can be used for grinding rectangular pieces as well.

Figures 3 and 4 illustrate a large plug gage, which is also used as a depth gage. It is ground cylindrically, one side being squared up with this operation. The gage is then finished to thickness.

In making these gages, they are bored out as shown in the drawing and a  $\frac{1}{8}$ -in. hexagon handle is fitted after finishing.

To prevent springing when the gage is ground cylindrically, a wood bushing is made to fit the large bore; this answers the purpose and allows for squaring the end.

Note the diamond holder in Fig. 3 on the magnetic chuck set at the height of the

*(Continued on page 113)*

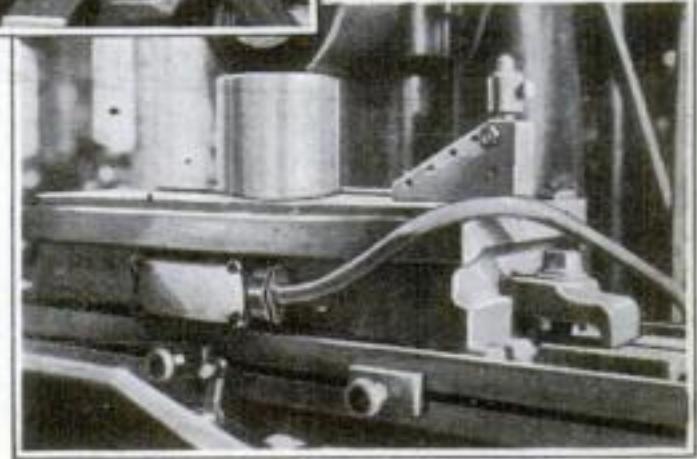
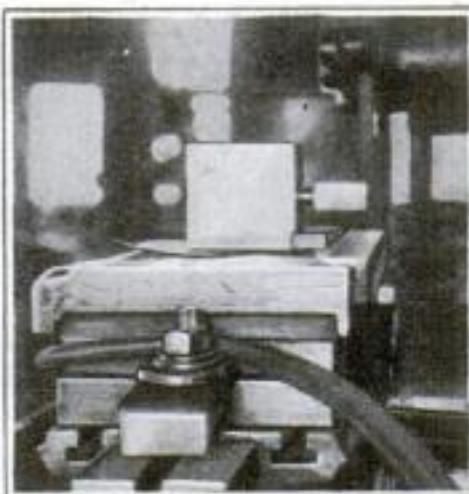


Fig. 2 (upper view). How a square punch is ground. Fig. 3 (lower view). Grinding a large plug gage, which is also shown in Fig. 4.

## Surface Grinding

(Continued from page 112)

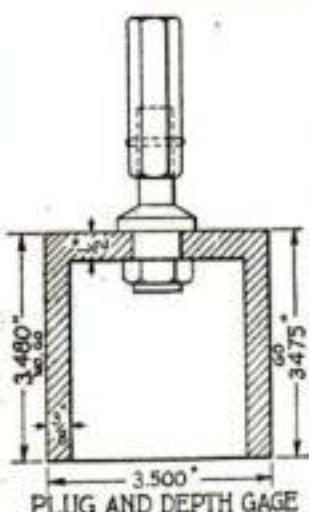


Fig. 4. A tool that requires careful work

milling snap gages, dovetail forming tools, and the like, the operator is guided by the graduated mechanism of the machine, which almost guarantees the results. On the other hand, when the same tools are being finished on the surface grinder, skill and good judgment are the only assets in favor of the man doing the work.

This is the second of two articles on the use of the surface grinder. The first was published in the September issue.

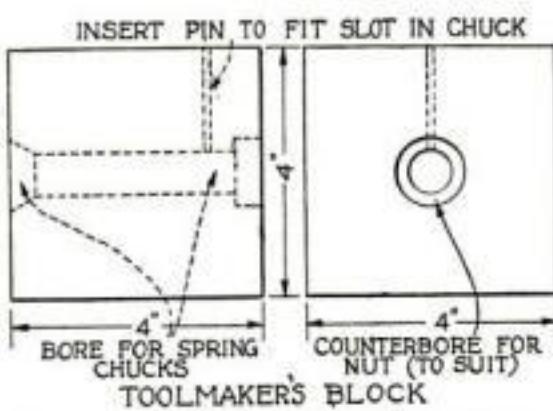
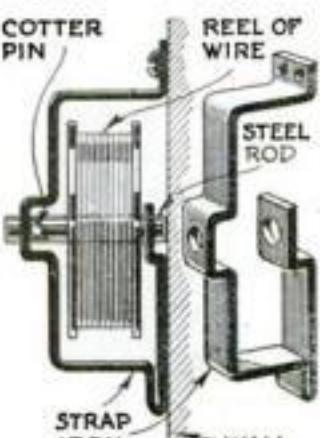


Fig. 5. All sides of this timesaving accessory are ground square to within .0002 in. in 1 in.

## Easily Made Reel Holders Keep Wire Handy

SPRING wire or magnet wire on reels always has a tendency to come off and get in the way. Whether the reel is kept on the bench or in a drawer or, as sometimes happens, is simply set down on the floor, the wire is apt to become gradually unwound, and soon it is a tangle. One foreman put a stop to this by having reel hangers made and fastening them to the shop wall about 4 ft. from the floor. Each holder was bent from one piece of light flat iron, provided with a pin for the reel and fastened to the wall with two screws. —G. A. LUERS.

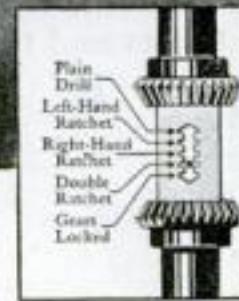


A simple method of making hangers for holding wire reels

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With “Yankee” Ratchet Breast Drill No. 1555, a finger touch on the Ratchet Shifter gives you DOUBLE Ratchet.

When set in this way, lack of room to turn the crank doesn't matter. The slightest movement of handle, either back or forth lets you drill continuously. Nothing need be removed. No lost motion. No lost time.

The four other ratchet adjustments shown above, and two speeds, make this “Yankee” Drill the handiest and fastest ever designed. You can change speeds instantly without removing drill from work. Just shift lever at base of hub.

Ratchet Breast Drill No. 1555 (Illustrated), 3-jaw; No. 555, 2-jaw. Hold  $\frac{1}{2}$  in. Drills. Ratchet Hand Drill No. 1545, 3-jaw; No. 545, 2-jaw. Hold  $\frac{3}{8}$  in.

For smaller drilling jobs use “Yankee” Ratchet Hand Drill No. 1530, with five ratchet adjustments.

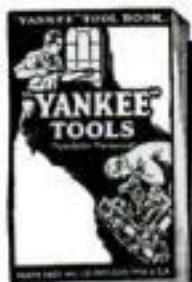
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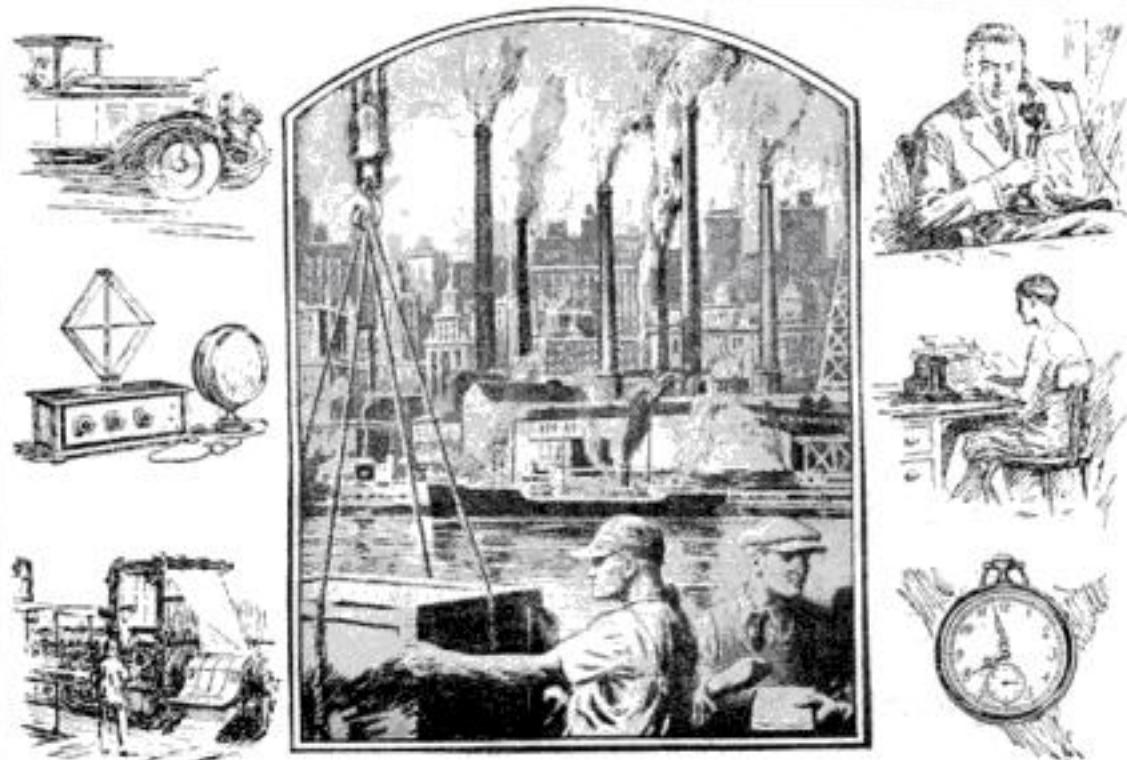
NORTH BROS. MFG. CO., Philadelphia, U. S. A.



“Yankee” Ratchet Breast Drill No. 1555

# “YANKEE” TOOLS

*Make Better Mechanics*



## Civilization Depends On Accuracy

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Precision tools make it possible to manufacture to very close limits and to make in mass production economically parts which can be assembled into a completed unit.



New adjustment — narrow anvil—shape of frame—and moderate price are features of Micrometer Caliper No. 11

Inside Micrometer No. 264 makes inside measurements from  $2\frac{1}{2}$  to 8" by thousandths—clamp screw is an exclusive feature

# BROWN & SHARPE TOOLS

"World's Standard of Accuracy"

Old  
Bill  
says—



DO NOT slight an oil hole just because it cannot be reached easily with the oil can spout. Insert a thin piece of wire in the oil hole and pour oil on the wire.

High speed steel drills get dull very quickly on slow speeds and feeds; they should be run at all times up to their rated speed and feed. Put on all the feed the work will stand.

To get the most work out of them, drills should always be ground on the machine if one is available. It is next to impossible to grind a drill correctly by hand.

A paper washer under the tool-post ring helps considerably when taking a heavy cut; oiling the tool-post screw also helps, as the tool may not be as secure as you think.

Some mechanics make it a practice when machining steel to start with a given feed and increase the speed until the chip turns blue.

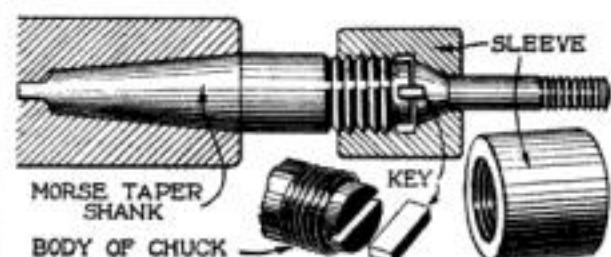
Any foreman likes to see a mechanic using a square nose or side tool with a  $\frac{1}{4}$ -in. side feed when finishing a cast-iron part on a lathe.

When grinding centers or any work on a lathe, be sure all bearings are protected from emery dust. Place wet waste or rags, or even a pan of water where the sparks strike.

Before starting a day's work on any machine, it is a good habit to grind up enough tools or tool bits to last all through the day. Considerable time can be saved in trips to the emery wheel, which in more than one shop is ingeniously located at a distance from pretty nearly all of the machines.

Filing left-handed near the chuck or faceplate is the safest method.

### Holder for Countersunk Screws



A simple fixture for holding screws which are to be cut off, pointed or rechased

WHEN it is necessary to rechase the thread of countersunk-head screws, or point or cut them off, the holder illustrated is a good one to use. The body is machine steel and a small strip of hard steel is peened or staked in to drive the screw.—G. A. L.

## Hunting Trouble in Shop Motors

By GEORGE A. WILLOUGHBY, E. E.

"I DON'T see what's gone wrong with the motor on this lathe," said Clyde as he threw in the switch and gave the belt a pull. "I have to yank this belt to get the thing started; if I don't, the motor growls like a dog."

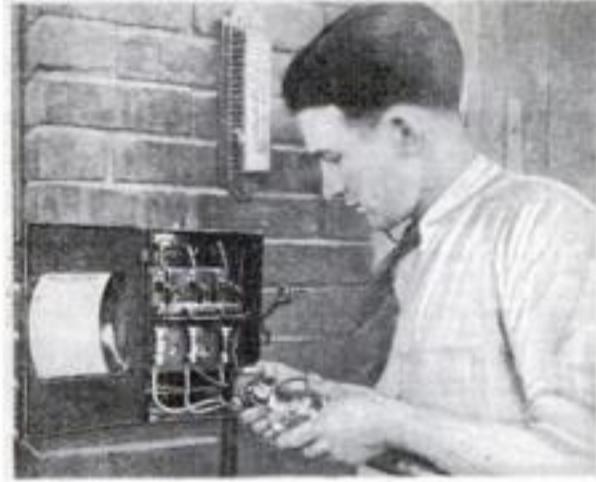
"How long has it been acting that way?" I asked as I walked over to the machine.

"Just since morning," he replied.

"Well, that's a good thing, Clyde, for running that way is hard on the motor. This is a three-phase motor and you're running it single-phase."

"It might be running four-phase for all I know. I don't know much about motors except to know that they don't work right once in a while and then I try to get an electrician to tell what's wrong and fix 'em up for me."

"This is simple, Clyde, and I'll explain what's wrong, and fix you a test lamp so



Testing the fuses of a three-phase power circuit with a lamp in a weatherproof socket

you won't need to have any more trouble like this. I'll get a 'pig tail' socket and bring it back with me right after lunch."

On the way to Clyde's shop that afternoon, I stopped at an electrical store and bought a weatherproof composition socket and a small 220-volt lamp. I got this type of socket because it is made of insulating material and there is no danger in handling it, and I chose a 220-volt lamp because the line to which Clyde's motor was connected was three-phase, 220-volt. That is, there were three wires and the voltage between any two of the three was 220. In some places it is hard to get 220-volt lamps and two sockets have to be connected in series and two 110-volt lamps used. Then one wire of one socket has to be connected to one wire of the other, and the two remaining ends used for testing.

Back at Clyde's little shop, I explained that when a motor acts like the one on his lathe, current is flowing through only two wires instead of three. The motor won't start, but it will usually run after it has been started, although not as it should. Probably one of the fuses in the switch box had blown when he had loaded the lathe too heavily, but perhaps a connection had loosened somewhere or a fuse wasn't making. (Continued on page 116)



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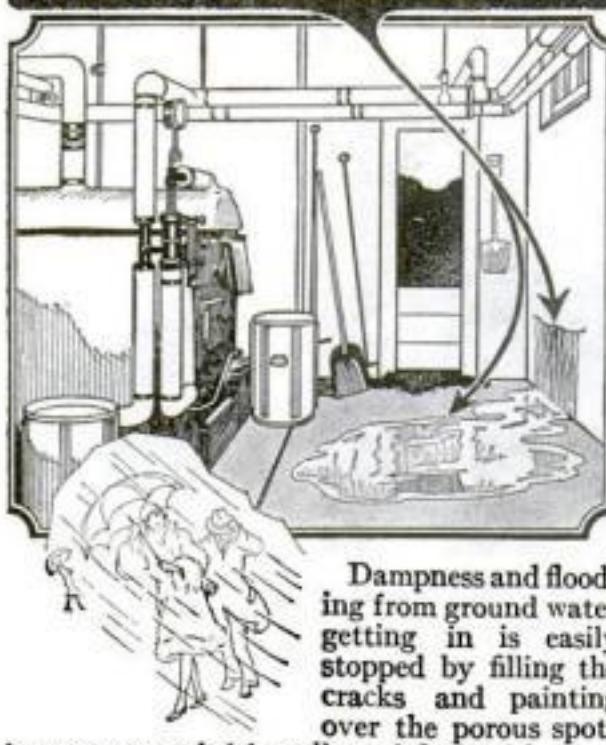
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## Convenient Holder for Valves to Be Filed

SMALL steel or brass valves, which have to be filed before regrinding, are sometimes difficult to hold. An excellent homemade holder for them is



A holder for small valves made out of an old Ford transmission band lug and a bolt

illustrated. This is made out of an old Ford transmission band lug. One side is tapped for a  $\frac{1}{4}$ -in. bolt, which is bent over to give a thumb grip. The bolt pinches a wing of the valve, the rest of which lies against the tapered boss at the front of the lug.—F. B.

## Hunting Trouble in Motors

*(Continued from page 115)*

good contact with the clip that held it in place.

"Here's your test lamp," I said. "Now we'll test the fuses. Touch the bare ends of the test socket wires on the first two fuse ends where the wires are connected. The lamp lights, so these are the feed wires and the fuses are ahead of the switch. If it didn't we'd try the next two and then if it didn't light we'd have to close the switch to make the test. Now put one wire of the lamp at the bottom of the second fuse and the top of the first so the current has to flow through the first fuse. That fuse is good because the lamp lights. Now try it with the one wire of the lamp at the bottom of the first fuse and at the top of the second; that lights too, so the first two fuses are good. Now try it with one wire at the bottom of the second and one at the top of the third. Just as I thought, the third fuse is blown, for the lamp doesn't light. The fuse at the left is blown and we'll have to take it out and refill it, but we'll have to do it carefully because they are 'alive'."

"Oh, I've got more fuses so we'll just put in a new one," said Clyde. So with a small piece of wood we took out the blown fuse and inserted a new one.

"If this hadn't been the trouble," I remarked, "we would have looked over the connections carefully and taken out the fuses and sandpapered the metal ends to make sure of good contact with the clips."

Since that time Clyde has not been troubled with motors that won't start.

A SELF-CLOSING water faucet of the type operated by pressing together the handles will serve in an emergency as a safety valve on water, air or oil lines.



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A 2c STAMP —will start you on the road to success. See Money Making Opportunities on pages 146 to 174.

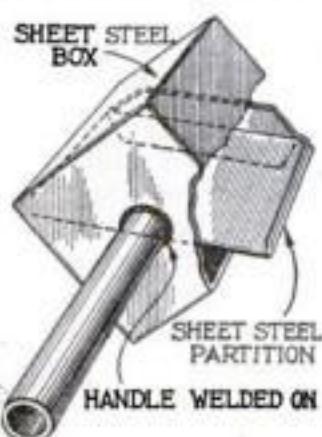
## Box for Heating Small Parts with a Torch

A GOOD way to save gas when an acetylene torch is to be used for heating small parts to be hardened, is to make a double holder like the one illustrated. This is made of sheet steel pieces welded together with a handle at the back. The central dividing piece is bent double and has the ends turned up.

Half a dozen pieces are placed in each compartment of the holder and the bottom ones are heated with a large flame. When the correct heat is attained, the holder is tipped to allow the work to slip out into the water. The upturned edges in the



The container has a diagonal partition

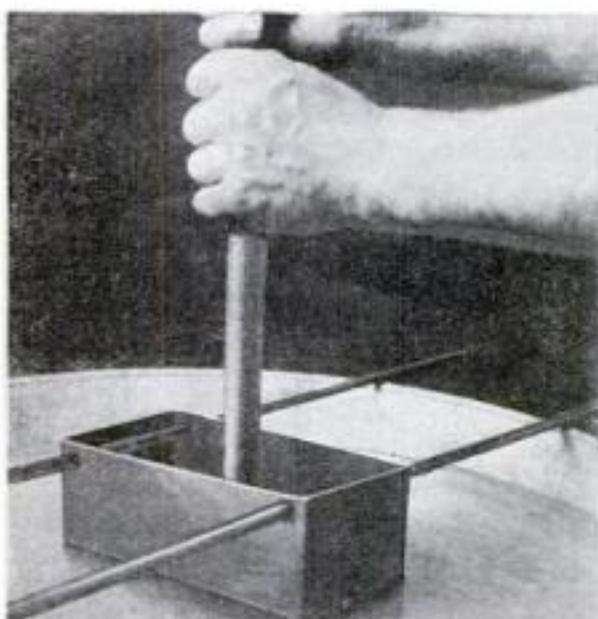


How the holder for small parts is made

center of the holder prevent the pieces in the upper half from slipping out, and this half is then turned down and more work placed in the top compartment. The work in the top half is thus pre-heated and requires less gas to bring it to the correct temperature for hardening.—A. K.

## Depth Can for Hardening Ends of Long Rods

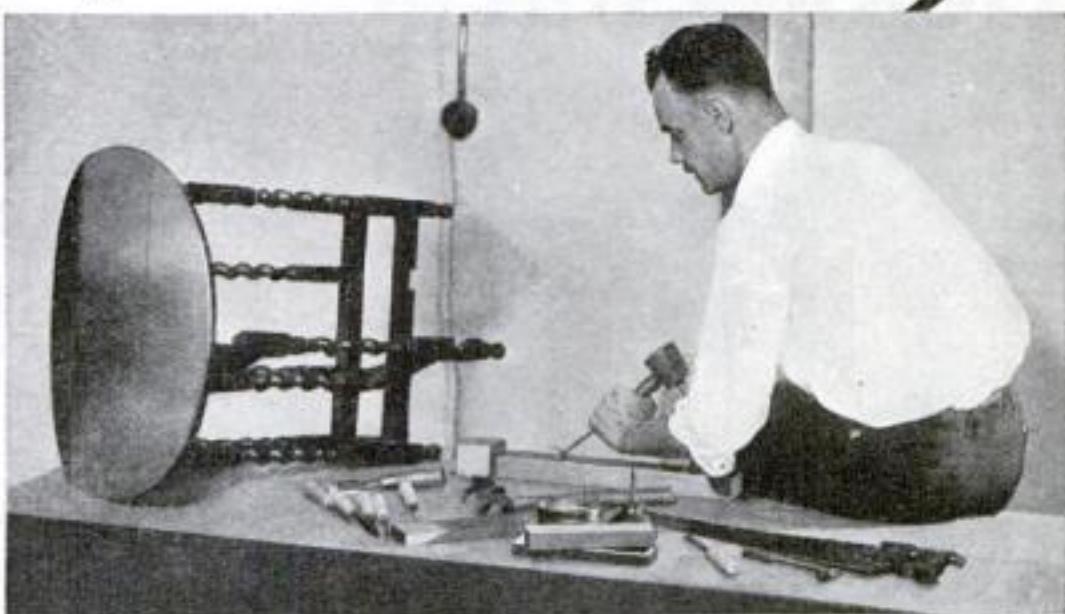
A BLACKSMITH had to harden a number of steel rods a uniform distance at each end. Before doing this, he pierced some holes in the sides of an



An auxiliary can used to regulate the depth for plunging heated rods into a water tank

old can and four holes near the top, and suspended the can as shown in the tank, which was filled with water to give the correct depth within the can. In this way he obtained the advantage of a full tank without any danger of hardening the bars farther than was necessary.—H. MOORE.

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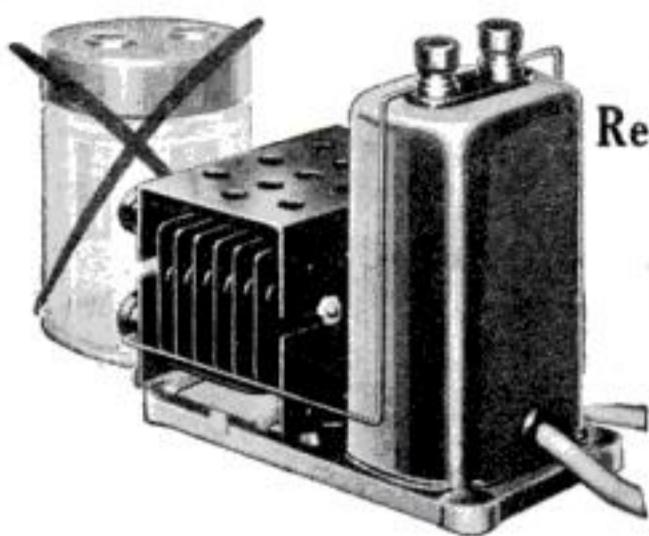
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Now you can convert your wet electrolytic trickle charger into a dry unit that never requires attention.

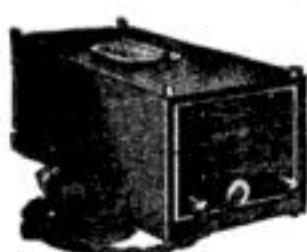
The sensational new KUPROX all-metal Replacement Unit replaces the old acid jar—eliminates all acids and liquids—all watering and attention. It doubles the former charging rate on most chargers.

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Unit in its place . . . only two simple binding post connections. Once installed, you need never again bother about your trickle charger . . . no watching or watering . . . no attention of any kind. One model fits all standard chargers.

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**KUPROX "A" TRANSFERS**—Batteryless, noiseless, electric "A" power. Dry, dependable, needs no attention. Operates any receiver. 4-volt or 6-volt, \$28.50 and up.



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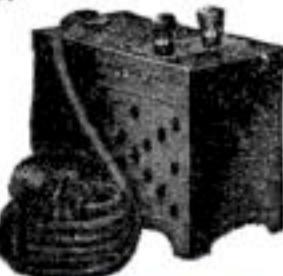


**KUPROX Replacement Unit**—For replacing acid jar on all standard trickle chargers and power units. \$4.50

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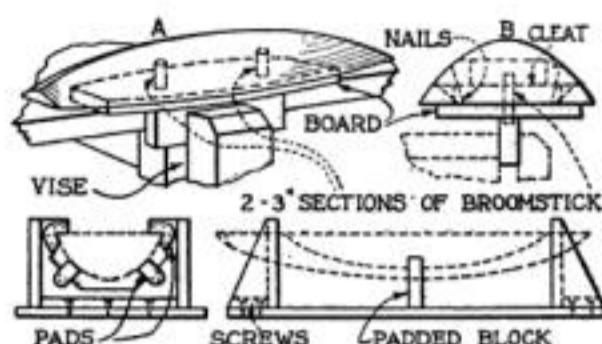
**KUPROX Trickle Chargers**—1-amp. rate. Large model gives 2½-amp. booster charge. \$10.50 and \$18.50.

**CINCINNATI, O.**

## How to Hold Ship Model Hulls for Shaping

IN THE construction of a number of boat models, I have always faced the problem of how to hold the unfinished hull while working upon it. At last I hit upon the two ideas illustrated.

The first is used when the outside of the hull is being shaped. It consists of a  $\frac{1}{2}$  in. thick table supported by a suitable block of wood with two pegs that enter loosely holes bored in the hull as at A,



Two methods of clamping a ship model for finishing outside and inside of the hull

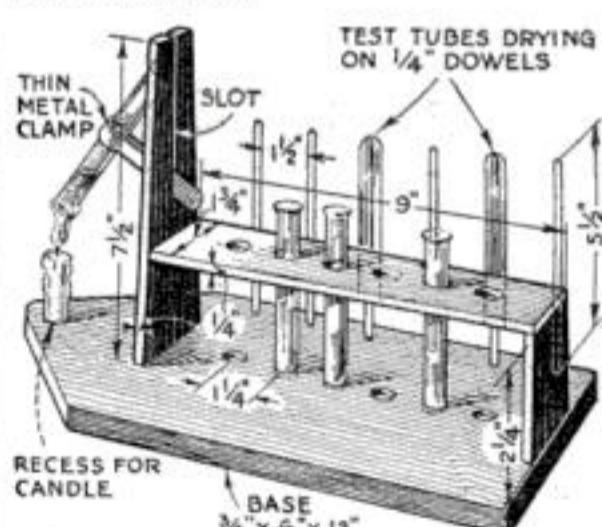
or into cleats fastened to the hull with finishing nails, as at B.

If the sheer of the deck has been cut, nail small blocks across the table to support the hull at several points.

The second method, which is for holding the hull while the inside is being gouged out, requires a cradle made of 1-in. stock. One jaw is fastened securely to one end of the base, while the other is attached with screws so that it may be quickly loosened and the hull released. After the hull is in the cradle, the small block in the center is wedged in place. The jaws are padded with several thicknesses of soft cloth, as is the central supports.—R. W. CHAPPELL.

## Handy Test Tube Rack for the Home Laboratory

AMATEUR chemists, or boys who are lucky enough to have toy chemical sets with which to experiment, will appreciate the value of a test tube rack like that illustrated.



A clamp for use when heating a test tube is a convenient feature of this wooden rack

It has the usual stand and pegs for the test tubes and, in addition, a clamping device which allows a tube to be held over either a candle flame or a small alcohol lamp.

## Decorative Metal Work

(Continued from page 73)

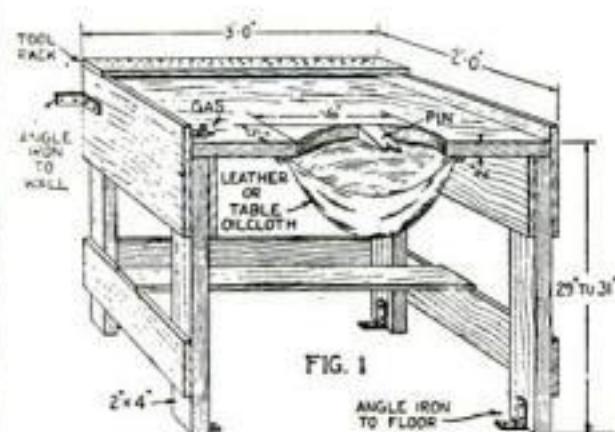


FIG. 1

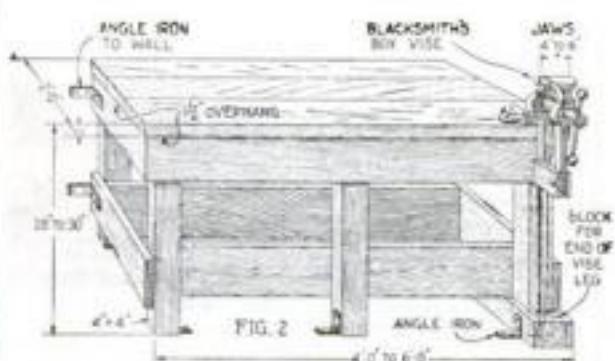


FIG. 2

A bench for light work (Fig. 1) and one with a blacksmith's vise for heavier operations (Fig. 2)

bench leg in a box of sawdust. This deadens the noise transmitted to the floor.

A north light is usually considered the best. Direct sunlight on the bench is very annoying and bad for the eyes. For night work at least two lights are needed, one on the right hand and one on the left, so that there are as few shadows as possible. It helps greatly if each of these lights is adjustable.

The soldering apparatus is best located in a rather dark corner, especially if you do any amount of silver soldering. You will be better able to see the glow of the metal and the solder. This is more important than it may sound.

When copper, brass, silver and most other metals are heated much, as for hard soldering or annealing, a scale or oxide forms on the surface of the metal. This must be removed (Continued on page 120)

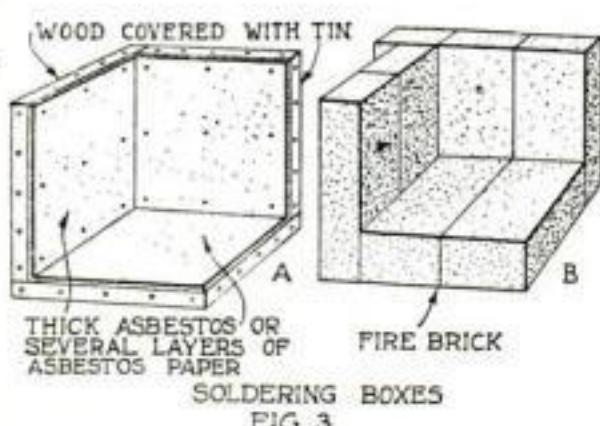


FIG. 3

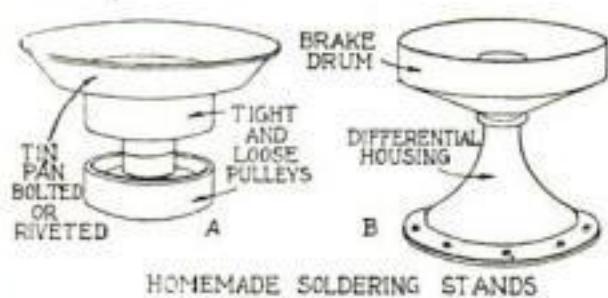


FIG. 4

Two ways of making a soldering box (Fig. 3) and two turntable soldering stands (Fig. 4)

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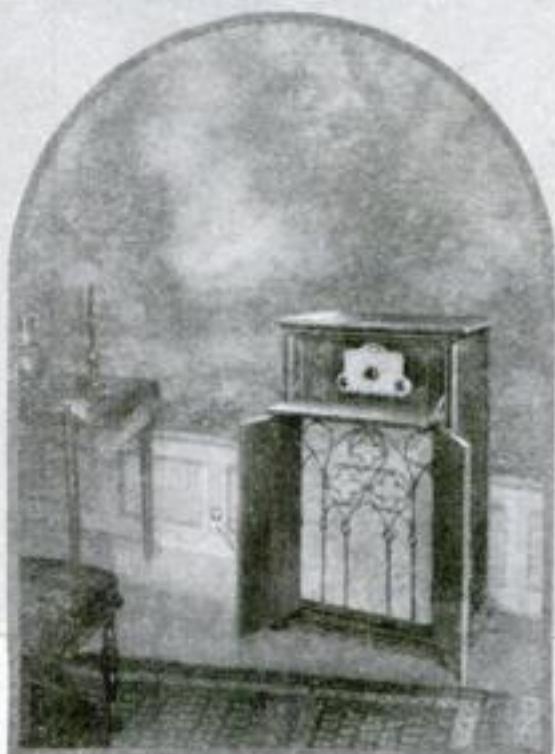
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Consulting Engineer, Gen. Elec. Co.

L. W. CHUBB  
Westinghouse Electric & Mfg. Co.

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In the creation of the New Electric 11 Receiver, Freed Eisemann has been able to use the inventions and patents of Alexanderson, Hazeltine, Langmuir, Latour, Loewe, Chubb, Nicholson and others—certainly the greatest radio engineers in the world.

**Operated from your Electric Light Socket—** There are no batteries or other attachments that need constant care. The Freed-Eisemann Electric 11 Receiver can be plugged into the light socket. Do not be confused. There are many electrified sets—sets that use, in one form or another, battery power units. This new Freed-Eisemann Set is not an electrified

set. It is a true electric set. The power in your electric light wires runs the set.

**Amazing Low Price—** Because of the demand for this remarkable receiver we have been able to manufacture it on a volume basis that has cut the cost of production to a point where the Electric 11 Receiver can be sold at a price within the reach of everyone.

Before you buy a radio set have the Freed-Eisemann dealer in your town demonstrate the marvelous Electric 11 Receiver. And let the dealer tell you about the Budget Payment Plan through which you can have this set in your home now. A demonstration costs you nothing and you will be thrilled with the ability of the Electric 11 Receiver to bring into your home the programs of all stations faithfully reproduced in full beautiful tones.

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## Decorative Metal Work

(Continued from page 119)

each time the metal is heated. The usual method is to dip the hot metal in "pickle," which is a mixture of water and acid



Art metal work by Mr. Thatcher. Later on he will tell how to make similar pieces

usually kept in an earthen crock near the heating and soldering apparatus. The pickle pot should have a tight cover.

Large pieces are best annealed and soldered (if the blowtorch is used) in a soldering box, which consists of two sides and a bottom as shown in Fig. 3, page 119. This may be made entirely of fire brick as shown at B. The purpose of the soldering box is to conserve and reflect the heat about the work and at the same time confine the flame safely.

Sometimes a pan of cinders, lump pumice stone, broken fire brick, asbestos, or charcoal is placed in the soldering box to hold the work and reflect the heat evenly. It is not a bad plan to cover that part of the bench to be devoted to heating and soldering with fire brick or even common brick.

The soldering box also provides an excellent place for a turntable, as shown at A, Fig. 4. The upper part consists of a shallow pan filled with refractory materials on which the work to be soldered is placed and turned about to best advantage for soldering. Two old machine pulleys that fit the same shaft may be used as a base, the upper pulley turning on a short piece of shaft. A tin pan may be riveted or bolted to the upper pulley.

The automobile junk yard will usually yield plenty of materials for making a turntable. Two brake drums may be arranged, or a wheel hub and a brake drum, as suggested at B, Fig. 4.

This is the first of a series of articles by Mr. Thatcher, who is a distinguished craftsman and teacher. He taught art metal work at Teachers College, Columbia University, for fifteen years. Many interesting facts about his work were given in the September, October, November, and December, 1926, issues of POPULAR SCIENCE MONTHLY. In the next article of the present series, he will tell how to set up various types of polishing heads and other equipment.

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## Handling Heavy Work

(Continued from page 78)

from the pile with the chain hook shown, or with a pair of shafting tongs, if a chain block is not available. The shaft is easily balanced on a floor truck and can be moved without much effort.

Suppose you have some bench work to do on several shafts that are rather awkward to handle in the vise on account of the length or the weight. It may be necessary to have another man close the vise for you while you are holding the shaft. Then, if you have to change the position of the shaft frequently, you will have to call on some one for assistance again. In Fig. 4 is shown a simple vise jaw that will support a shaft and enable a man to handle the work alone. It can be quickly made from sheet steel, copper or

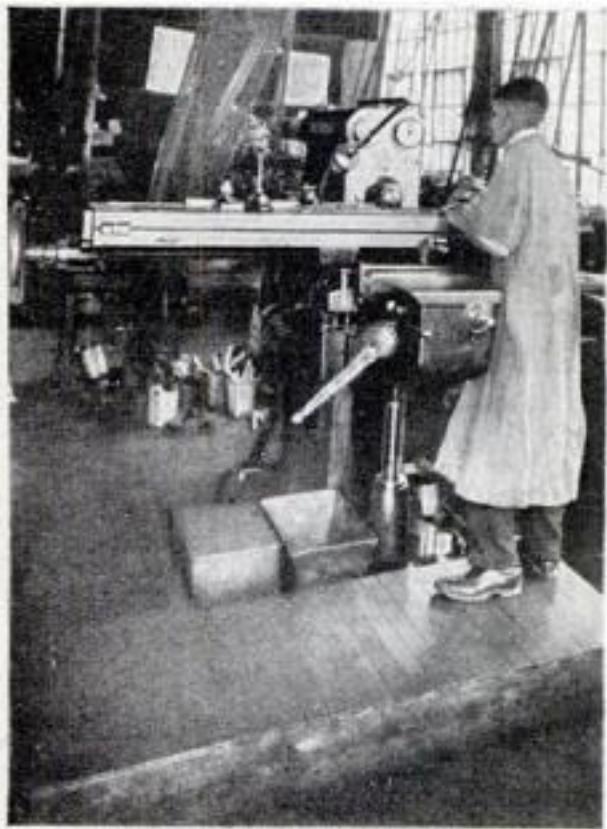


Fig. 3. A floor platform before a machine or bench will often save a mechanic fatigue

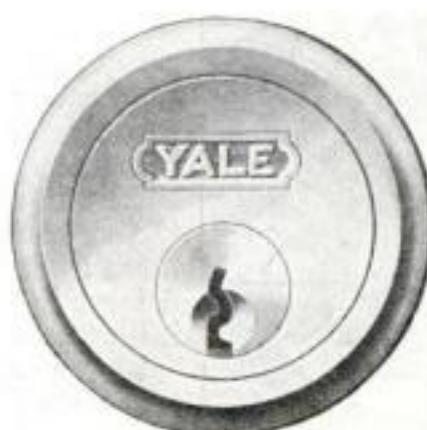
brass. The jaw is cut the width of the vise and long enough to curve around the shaft and lap over about 2 in. on each jaw when the vise is closed. It is first bent around the shaft, and after the shaft has been locked in the vise, the ends are turned over. This type of cradle can be made in a few minutes and will often save a lot of energy. You can open or close the vise as often as you wish, yet the shaft will remain at the right height, and it can be moved longitudinally or turned around.

Another simple kink is to place on the sliding bar of the vise a block of wood, cut to the proper height. The block should be grooved on the side resting on the bar so that it fits over sufficiently to hold the block in place.

An important consideration in connection with vise work is to stand at the right height, especially if you have to spend many hours at the work. Unfortunately it is impossible to build long shop benches that will be just the right height for both long and short men. The only thing is to try to strike a happy medium. This applies also to many large machines, such as

(Continued on page 122)

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MEN ENFORCE RESPECT FOR  
THE DIFFERENCE BETWEEN  
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*Specify*  
**Belden**  
Aerial Kit

## Handling Heavy Work

(Continued from page 121)

as engine and turret lathes and millers.

When you find the vise or machine too high to work at constantly without becoming tired, the best remedy is to make a small platform, as shown in Fig. 3. It may be from 1 to 4 in. or more high.

In many shops heavy machine accessories such as index heads for milling machines, chucks and faceplates for lathes, and machine vises, are kept on the floor near the machines. Some of these are too heavy for one man to lift. A large index head for a milling machine is difficult even for two men to handle.

To make the job easier, the machine table should be lowered to its lowest position. On modern machines this can be done speedily with power. Loosen the column clamping bolts and throw in the fast feed gears and a high spindle speed; then let the table down to its lowest position, but be sure to watch the differential nut underneath the table to see that it doesn't jam against the shoulder of the threaded hole. Stop the machine about  $\frac{1}{2}$  in. away from this shoulder. Lowering the table in this way makes the necessary lift for the heavy dividing head that much shorter and easier.

A truck adapted for holding a dividing head is shown in Fig. 2. For this purpose a stand may be built of wood and provided

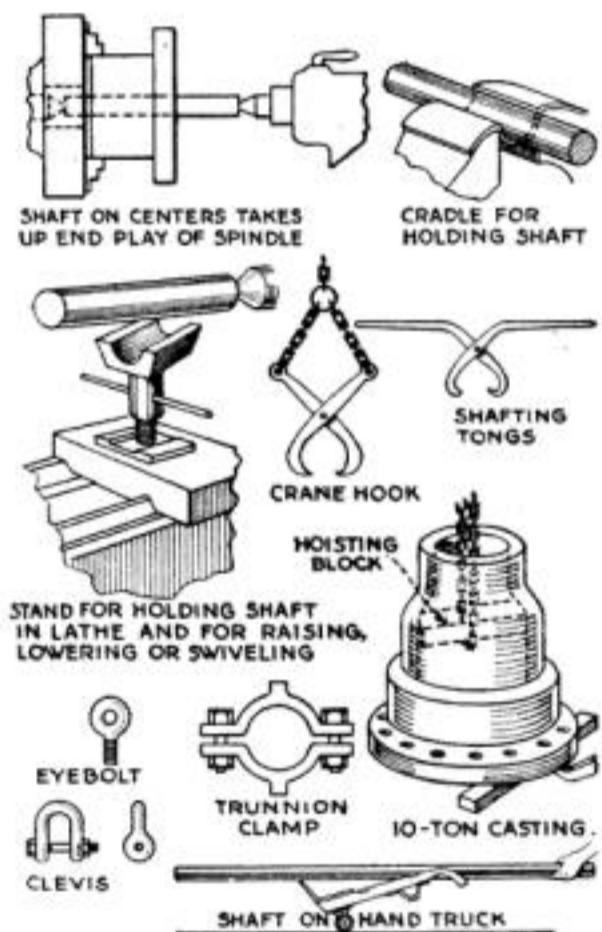


Fig. 4. Methods of supporting work in lathe and vise and for moving castings and shafts

with casters, the height corresponding with the minimum height of the machine table. This will enable a man to slide the dividing head on or off the machine without help. It has another advantage in keeping the head off the floor and in much better condition than that in which these expensive accessories are sometimes found.

If desired, the lower section of the stand can be made (Continued on page 123)

SEAVIER-WILLIAMS CO. BOSTON-MASS. SW

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## Handling Heavy Work

*(Continued from page 122)*

into a cabinet for smaller parts of the machine, the tail center, bolts, wrenches, and the like. Similar stands can be made for holding heavy lathe chucks and faceplates.

When mounting a large chuck or faceplate on the lathe, a board or blocking should be placed across the ways. When the same machinist is working steadily on one lathe, he can have a board or block just high enough to bring the threaded hole in the chuck in line with the spindle. He can move the chuck along the ways with the carriage, and by pulling on the belt the chuck or faceplate can be easily started. One man can handle a very heavy chuck in this way unless it has to be lifted from the floor.

Some mechanics make heavy work of removing a chuck or faceplate, especially if the thread starts hard. Many times a chuck has a tendency to jam against the shoulder. To start it easily, place a hardwood block under one of the chuck jaws at the back of the lathe. With the block resting on the way and with the back gears in, pull on the belt in the reverse direction, bumping the chuck jaw against the block.

Another method is to place a short iron bar obliquely between two chuck jaws, allowing one end of the bar to come against the back way of the lathe; then pull on the belt. After the thread has started, the chuck can be run off with the power on, using a slow speed until the thread is nearly off; then stop the lathe and take the last turn or two by hand. Always have a board across the ways so that if the chuck accidentally gets away from you, it will fall on the board and do no damage.

**CHUCKS** that have a tendency to stick hard against the shoulder on the spindle may often be relieved by placing a thin metal washer or heavy paper gasket back of the hub.

If you have to place a heavy shaft in a lathe, use blocking in the center, or at each end if the shaft is a long one. Even where lathes are large enough to be served with a crane, blocking under the job is useful and also a safety precaution.

Suppose you are cutting a thread on the end of a big shaft and must remove the center several times to try on a nut or a gage. With a short piece of board across the ways or the carriage, one or two short blocks up to the shaft will support it while the center is withdrawn (see Fig. 1, page 78). Removing the tool post when placing long or awkward work in the lathe will also save some time, as the tool post is generally in the way.

Heavy castings that must be trued up in the chuck can be held safely if a short bar or hardwood stick is used between the tail center and the work. A light pressure with the tailstock spindle against the work will prevent accidents and make the job of truing up the piece much easier.

Trouble is often experienced when facing off a large casting held in the chuck, the main difficulty being to get a straight cut. This is

*(Continued on page 124)*

## THE NEW MODEL 9-In. JUNIOR SOUTH BEND LATHE

A Precision Lathe — Back Geared — Screw Cutting



### A Precision Screw Cutting Lathe

Practical for handling the finest work in the machine shop, manufacturing plant, tool room, Service Station and Electrical Shop.

### 50 Sizes and Types to Select from

Below we list the prices of the countershaft driven lathes with different length beds. Can also be furnished in motor driven types.

### Prices of 9-in. Junior South Bend Lathe including Countershaft and Equipment

9" x 2 1/2" Bench Lathe, 11" between centers.	[Shipping Wts.]	with plain rest, \$160.00 — with compound rest \$170.00
9" x 3" Bench Lathe, 18" between centers.	375 lbs.	with plain rest, \$165.00 — with compound rest \$175.00
9" x 3 1/2" Bench Lathe, 23" between centers.	400 lbs.	with plain rest, \$170.00 — with compound rest \$180.00
9" x 4" Bench Lathe, 29" between centers.	425 lbs.	with plain rest, \$175.00 — with compound rest \$185.00
9" x 4 1/2" Bench Lathe, 36" between centers.	450 lbs.	with plain rest, \$180.00 — with compound rest \$190.00

### Features and Specifications

Automatic Feed to Carriage.

Set-over for Taper Turning.

Hole through Spindle..... 1/2 in.

Spindle Speeds..... 48 to 714 R.P.M.

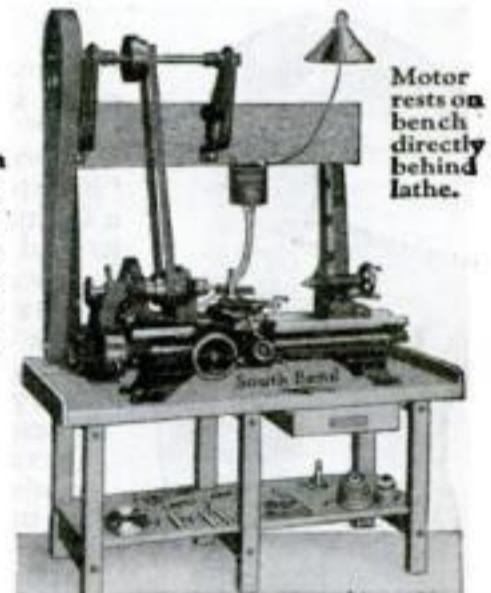
Width of Belt..... 1 in.

Maximum Draw-in Collet Size..... 1/2 in.

### 9" x 3' New Model Junior Self-Contained Motor Driven Bench Lathe with Motor, Switch, and \$253 Belts.



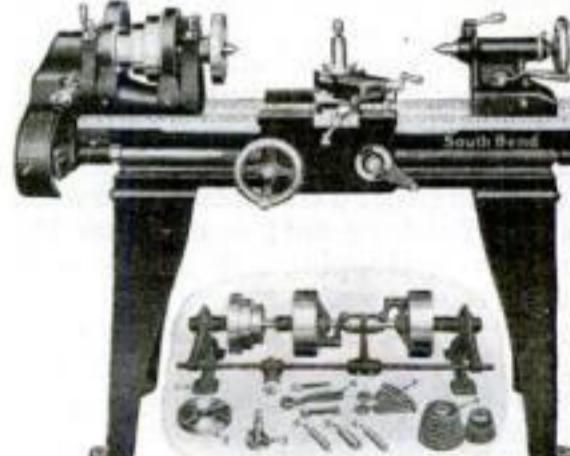
Operates from  
Lamp Socket  
1/4 H. P. Re-  
versing Motor  
and Reversing  
Switch connect  
directly to  
nearest lamp  
socket without  
extra wiring.



9" x 3' New Model Simplex Motor Driven Bench Lathe with Motor, Switch, Belts and Counter-shaft, but not Bench. \$239

### Practical Attachments

9" Junior Lathes can be fitted with Milling Attachment, Taper Attachment, Draw-in Collet Chuck, Threading Dial, Grinding Attachment and 12 other practical attachments.



9" x 3' Junior Screw Cutting Back Geared Lathe with floor legs. \$185  
Equipment shown beneath the lathe furnished as regular equipment with all the countershaft driven lathes, including the bench lathe shown at top of page.

Established 1906. Over 38,000 South Bend Lathes in use.

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These are some of the reasons why "Give me a TRIMO" predicts a sensible purchase.

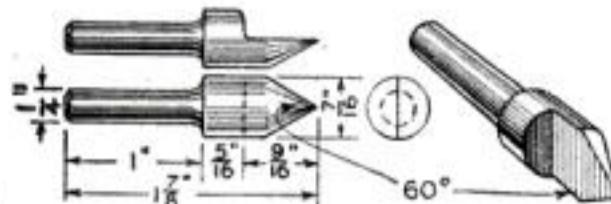
# TRIMO

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### Making Center Reamers in the School Shop

USEFUL as well as instructive is the school shop project illustrated below—a center reamer. This tool should be a part of every mechanic's kit. Making one provides practice in the use of lathe tools and in the art of tempering steel. The tools required are: Hack saw, 6-in. steel rule, outside calipers, tool holder,



This useful center reamer will give young machinists excellent experience in turning

center gage and file, forge, tongs, and, of course, a lathe.

The operations are as follows:

1. Cut off a piece of tool steel stock 2 in. long.
2. Chuck in engine lathe and face off.
3. Turn  $\frac{1}{4}$  in. diameter.
4. Reverse work in chuck and face off end.
5. Turn  $\frac{3}{16}$  in. diameter.
6. Set compound rest on engine lathe to proper angle.
7. Turn 60-deg. taper.
8. Hold in vise and file cutting edge to center line.
9. Harden.
10. Polish.
11. Temper.

Note that operation 8 could be done on a milling machine.

This is the second of a series of projects which the writer had found particularly useful in high school machine shop work. Others will follow from time to time.—H. B. KELLAM.

### Handling Heavy Work

(Continued from page 123)

generally caused by slight end play in the spindle. I have seen mechanics take several cuts across a large casting and then fail to get a true face. Taking up the end play with the adjusting nut on the back of the spindle does not always eliminate this trouble, but if there is a hole through the casting, place an arbor on the centers through the hole and take up the play with the tailstock spindle (Fig. 4). The arbor runs freely on the centers while the work is being faced. If there is no hole in the work, the next best thing is to put a true center in the end and run the tailstock spindle against the work. With this arrangement it is possible to get a true face on the work with one finishing cut; it also has the advantage of stopping any tendency of the work to chatter.

In offering these suggestions, my main purpose is to get mechanics to think of ways to make their work easier and avoid unnecessary physical strain and hard labor. Some men never seem to hurry and yet accomplish a great deal more than those who are always flying around. And it is not uncommon to find two men doing what one man could do alone if a little more intelligent thought had been given to the matter of handling work in the shop.

THE weight of sheet iron can be computed by multiplying the thickness by 40. This gives the weight in pounds a square foot.

## New Self-Massaging Belt REDUCES WAIST -Easily!

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Formerly those who wished to reduce without dieting or strenuous exercise had to go to a professional masseur. His method brought about the desired reduction. But it was expensive and time-consuming, and few could take advantage of it.

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Gentlemen:—Please send me without obligation, complete description of the Well Scientific Reducing Belt and your special 10-day Trial Offer.

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Address.....

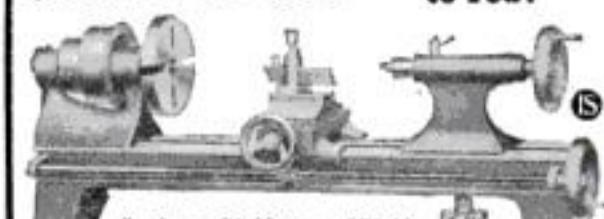
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# The Shipshape Home

## Ventilating Hood

THE hood illustrated below fills a long-felt need in the kitchen not provided with a built-in ventilator over the gas range. The odors of cooking foods, steam of boiling kettles, and fumes of the oven are carried away.

Top, front and back were fashioned of a rectangular piece of medium weight galvanized iron, 20 by 63 in., bent into the three sections. The type of gas range naturally controls the dimensions to some extent.

The two sides, which are 34 in. long and 20 in. wide, were cut out with  $\frac{1}{2}$ -in. extra allowance

at the edges. This margin was bent at a right angle as a flange to which to solder the main sheet.

The construction could be simplified greatly by eliminating the curved edges of the side pieces, but the writer thought these curves would give the cook more working room and improve the looks of the hood.

The lower edge rests on the shelf of the range and is held to the back by two stove bolts. To prevent the hood from falling forward, an upright bar was bolted to the back of the hood near the top; it projects downward and is attached behind the range. This makes unnecessary any attachment to the back wall.

Short sleeves were inserted in the sides near the top, at one side for the narrow pipe from the oven and at the other side for the 6-in. pipe leading to the chimney. A simpler method would be to cut accurate circular holes in the hood to admit the ends of the pipes.

Finally, the outside of the hood was painted gray to match the walls of the room, and the inside enameled black. Visitors inspecting the kitchen believe the hood to be an integral part of the range.—OWEN LOVEJOY.

## Basement Storage Racks

A GOOD WAY to use the overhead space in any unfinished basement or cellar is to nail a few strips of ordinary building lath up against the floor joists. One lath is generally long enough to span three joists.

Two such laths placed close together near the basement wall will make a rack for large pans and (Continued on page 126)



Homemade hood carries off fumes of cooking



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It was recently predicted that city congestion would eventually force architects to use the upper structure of bridges for apartments.

When the time comes to build these apartments, NICHOLSON Files will be just as useful as they are in the building trades today.

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**Knapp Lathe No. 930**  
Turns wood up to 5 in. length, 2 1/2 in. diameter. Tool rest, head rest, tail stock all fully adjustable. Complete with 3 step pulley, 3 high grade cutting tools, and instruction book.

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Samples of work done on the Knapp Lathe with Outfit 935, consisting of 12 interesting and useful turning designs, and templates, 43 white pine blocks, 5 in. long, from 1/4 to 1 1/4 in. diameter.

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Sample of work done on Saw No. 900 from Outfit 902 which consists of 20 boards, 4 1/2 x 12 x 3/16 in., and 12 designs for making everything from toys to practical household articles.

**Outfit 902, \$2.00**  
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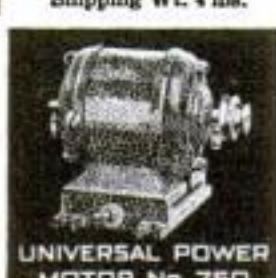
**Knapp Speed Drill No. 910**  
Takes 1/16 in. to 3/16 in. dia. drills. Drills wood, iron, copper, brass, aluminum, lead, slate, bakelite. No workshop, whether you work wood or metals, complete with outcone, instruction book.

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**Knapp Universal Motor No. 750**  
1/35th horse power, a.c., d.c. 105-130 volts, any commercial frequency. Equipped with switch, 2 step pulley, 6 ft. cord, separable plug. Hard drawn copper commutator, mica and bakelite segment insulation, bronze bearings.

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## The Shipshape Home

*(Continued from page 125)*

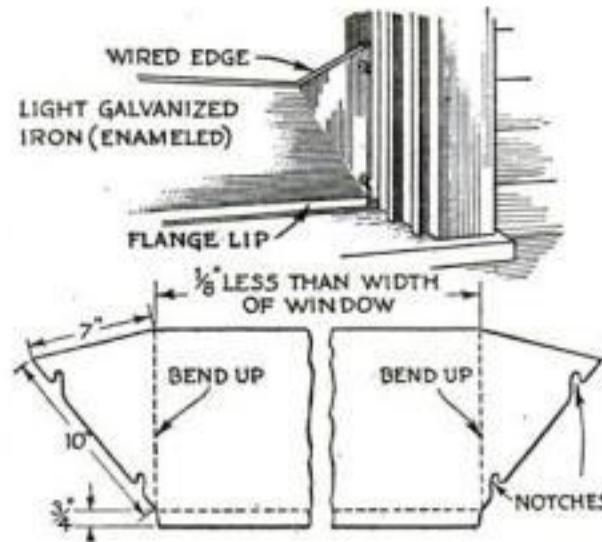
fruit kettles not often used in the kitchen. Others placed near the center of the basement or above the coal bin will hold spare stove pipes or small storm windows.

During the winter, garden tools can be kept in the same manner, if no outhouse is available. Close by the workbench short lengths of wood and molding may be kept handily overhead.—ERIC B. ROBERTS.

### Window Ventilators

THIS window ventilator is constructed of light galvanized iron stiffened along the upper edge with wire.

Notches are cut at the ends to slip over round-head screws placed in the window-stop molding. The window can be lowered



How to lay out, cut, bend and attach a simple type of galvanized iron window ventilator

practically all the way without removing the ventilator.

Our ventilators are enameled. They are kept in place whenever the weather is at all doubtful. They regulate the draft, keep out all rain and snow, prevent the window sills from weathering, save the bother of pinning up curtains and prevent all worry as to whether rain may drive in.—W. S. PICKRELL.

### Marking Screens

WINDOW and porch screens should be marked carefully to

identify them as they are taken down to be stored for the winter.

One of the best ways is to use small nails with numbered heads, which can be obtained for a few cents at any well stocked hardware store. Take the screens down in orderly progression and fasten a number to each and to the window frame.

Another method, which is almost as simple and has the advantage of being indelible under all circumstances, is to mark the screens with Roman numerals, (I, II, III, IV, V, etc.) made by driving a 1/2-in. chisel into the edge. The screens for the second floor may be prefixed by a Roman II. To avoid any possibility of mistaking IX for XI, underline each with a chisel mark. Mark a few of the window frames to correspond, so that there will be no chance of forgetting where the numbering was started and in which direction it was carried around the house.—B.H.F.



**What Caused It?**

Here is a remarkable picture of the greatest tornado that has swept across the West in recent years; it's only one of the scores of extraordinary pictures in the Popular Science Library.

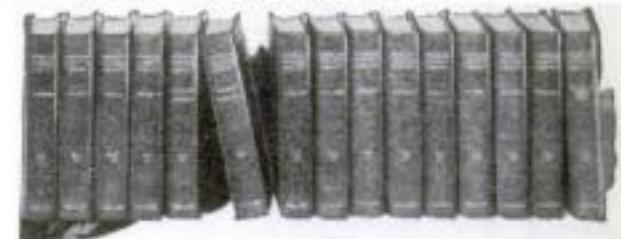
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## The Stage Carpenter

(Continued from page 80)

first meeting Jerry and the director will go over their combined jobs from reading the play to figuring out not only how the sets should be arranged, but also, as it happens in many cases, what will be needed in the way of a stage, dressing rooms, additional partitions, screens, and so forth.

If the director has just met Jerry for the first time, it might be just as well at the outset to agree upon the meaning of the word "stage."

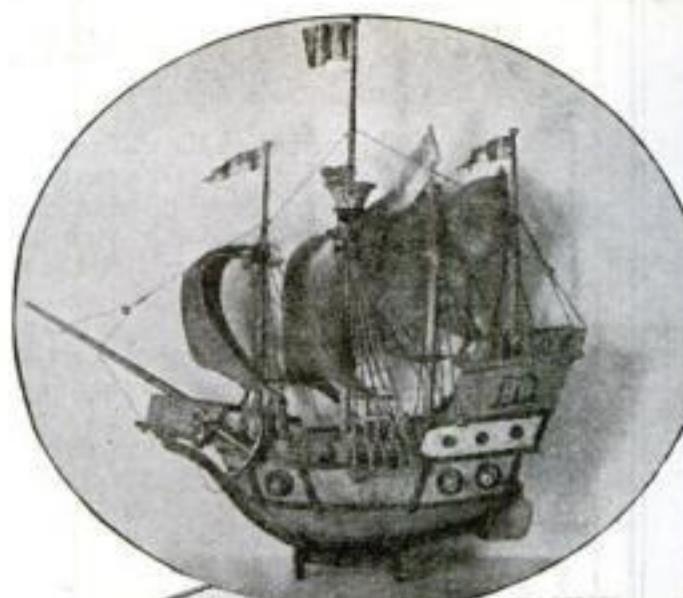
A FEW years ago I suffered a couple of bad days of worry for the simple reason that what I meant by the word "stage" didn't agree at all with Jerry's meaning. We were to put on a musical show in the town armory, and never having been in the armory or seen any of the shows that had been put on there, I asked Jerry if they had a good stage. He assured me that they had, and he seemed surprised that I didn't know that it had been donated to the town by the president of the Lock Works. Anyway, it sounded all right to me. As I was still bright green in the producing game, I let the matter of the settings go until about three days before they were needed. It was in this eleventh-hour scene confab with Jerry that I suffered the shock of revelation. What Jerry meant by a stage was not a regulation theatrical stage, but merely a *platform*!

When I could talk calmly and ask questions I learned that Jerry's "stage" was a twenty by twenty-four foot platform set up on horses two feet above the armory floor. It had no front, no proscenium arch, no sides, no means of lighting and a curtain that consisted of a number of frowzy blankets nailed to a two-by-four and hung from the armory roof girders, to be raised and lowered as need be. When the curtain was down, the two-by-four was just high enough above the stage floor to conceal a man's head, provided he was not over six feet tall; when the curtain was up, its lower natural fringe was about five-foot-six above the platform floor. With the dress rehearsal only three days off, it is needless to say that Jerry and I did some tall hustling to get his "stage" to come somewhere near the specifications of mine. And all this worry because he and I hadn't sounded each other on the clear meaning of the word.

IT IS just as well to take a good look at the stage at the first opportunity, unless you already know all about it, its conditions and limitations. And what I mean by taking a good look at it consists of not merely seeing it with your eyes but examining it with a tape measure. Measure it off and lay it out on paper, making a plan which shows the stage area, the proscenium opening, the location of side walls (if they exist) and the location and size of door openings onto the stage, if it happens to be one of those closed-in stages common to many small-town halls, schools and church "parlors."

I recall a near-tragedy that occurred from a lack of a little of this sort of forethought, or rather, fore-measuring. The play we were putting on called for two interior sets. The settings were made a few days ahead of time, but not put in use until the first dress rehearsal, two nights before the public performance. Since our Drama Club was able to hire the entire hall for a week before the show, the scene frames were built, covered and painted out in front, in the auditorium. When set up they were, of course, carried to the stage by way of the proscenium arch. The set for Act I was put in place ready for the night rehearsal. At the end of the act, when the time came to make the shift to the second-act set, Jerry started to take the first set backstage. But he only got as far as the door. It was then that he discovered that the

(Continued on page 128)



SPANISH SHIP MODEL

See LePage's Book, page 4



SMOKING CABINET

See LePage's Book, page 13



PRISCILLA SEWING BOX

See LePage's Book, page 11



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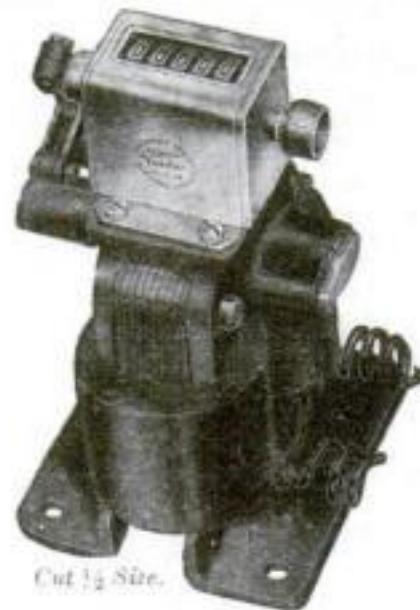
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## The Stage Carpenter

*(Continued from page 127)*

frames were all bigger than the door openings. In the meantime willing workers were hustling the Act-II sets up over the footlights and on to the stage. You can imagine the mess that followed—the confusion not only on the stage but also in the mind of distracted Jerry. Here was a small, closed-in stage containing the disjointed elements of two perfectly good but unremovable settings... and Jerry foaming in the midst of it all. And what did the poor man do? He spent the entire next day in an agony of rebuilding his two sets so that each would allow for storage space for the other.

I MUST admit that he came out of his confusion in good order. In each of the rooms he built a slightly projecting jog which was just deep enough to hold all the frames of the other set. And he was clever enough to locate this storage "wart" differently in each set so that a too critical observer would not suspect his dodge. A fairly reliable tape measure and a few minutes of its application to that stage and its surroundings before the sets were designed would have saved Jerry all that anguish and an extra day of frantic labor.

When I stress the importance of the stage carpenter I have in mind just such distressing upsets that occur from time to time in even the best regulated families of amateur players. For that reason the stage carpenter-designer has to be able to use his head fully as well and as actively as he can his hands and his tools.

THE old days when a few side wings and a backdrop stood for a room interior have passed. Today even among the most amateurish bunch of beginners, a stage room has to look like a real room with merely one side of it omitted in order to give the audience a look-in. Actors no longer make magical entrances from the side of nowhere, but come through actual door openings, with real doors; they open and close what seem to be workable windows, and the fireplace before which they sit seems comfortably safe to even the most exacting fireman in the audience. And instead of having a few waving strips of cloth suspended over the actor's heads to conceal the back rigging of the stage, the interior set has a ceiling that is flat and looks solid. And all this is the work of the stage carpenter.

And so when the curtain goes up on a setting that pulls an immediate round of applause, Jerry can figure that at least ninety-nine percent of that particular burst of glory is all his own.

This is the first of a series of articles on making scenery for amateur theatricals. In the second article, which is scheduled for early publication, Mr. Smith will discuss the making of preliminary models.

## How to Finish Curtain Poles in Polychrome Effects

CURTAIN poles may be polychromed by giving them two coats of flat wall paint, the second of which has been thickened with a little plaster of Paris. Before it has a chance to dry, tap it with a stencil brush or any other stiff brush to give the surface a rough texture. When this is dry, apply a coat of glazing color of some contrasting or harmonizing tint. This may be made from painters' tinting colors ground in oil or in japan and thinned with turpentine. Apply the glazing color irregularly and mottle it with a rag. The colors should harmonize with the draperies.

If a more antique looking polychrome effect is desired, apply powdered rottenstone mixed with turpentine and after a few minutes wipe off the greater part of the powder.

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## Better Heating

(Continued from page 84)

and this type of instrument be used to operate the furnace entirely by natural draft. As an experiment the author kept a furnace fire until June 10th, though the house temperature did not rise above 70 degrees except when the outside temperature rose above that. Thermostat control early in the fall prevents overheating, which is a prevalent cause of colds.

Models available include: 1.—A plain instrument with no clock (the alarm clock described later may be installed). 2.—A 24-hour non-jeweled clock. 3.—An eight-day nonjeweled clock. 4.—An eight-day seven-jeweled clock.

Number 1 has no provision for maintaining a different night temperature except by setting to a day temperature on arising. By means of the alarm clock switch it may be turned on before arising, the fire having been on natural draft all night. Number 2 will maintain any desired night temperature and, by means of the clock, shift to the day range. Number 3 does the same except that the clock requires

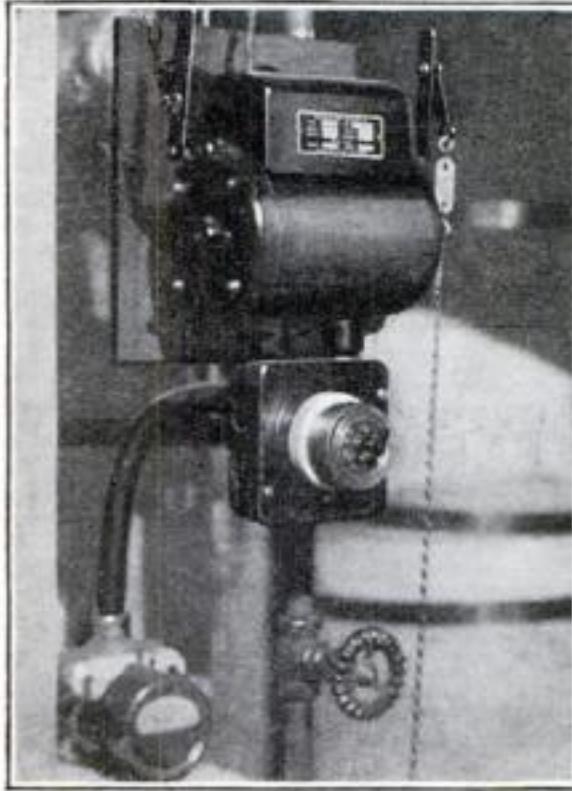


Fig. 3. Electric control motor which operates the draft door and check damper and turns the blower on and off according to a prearranged program without any attention

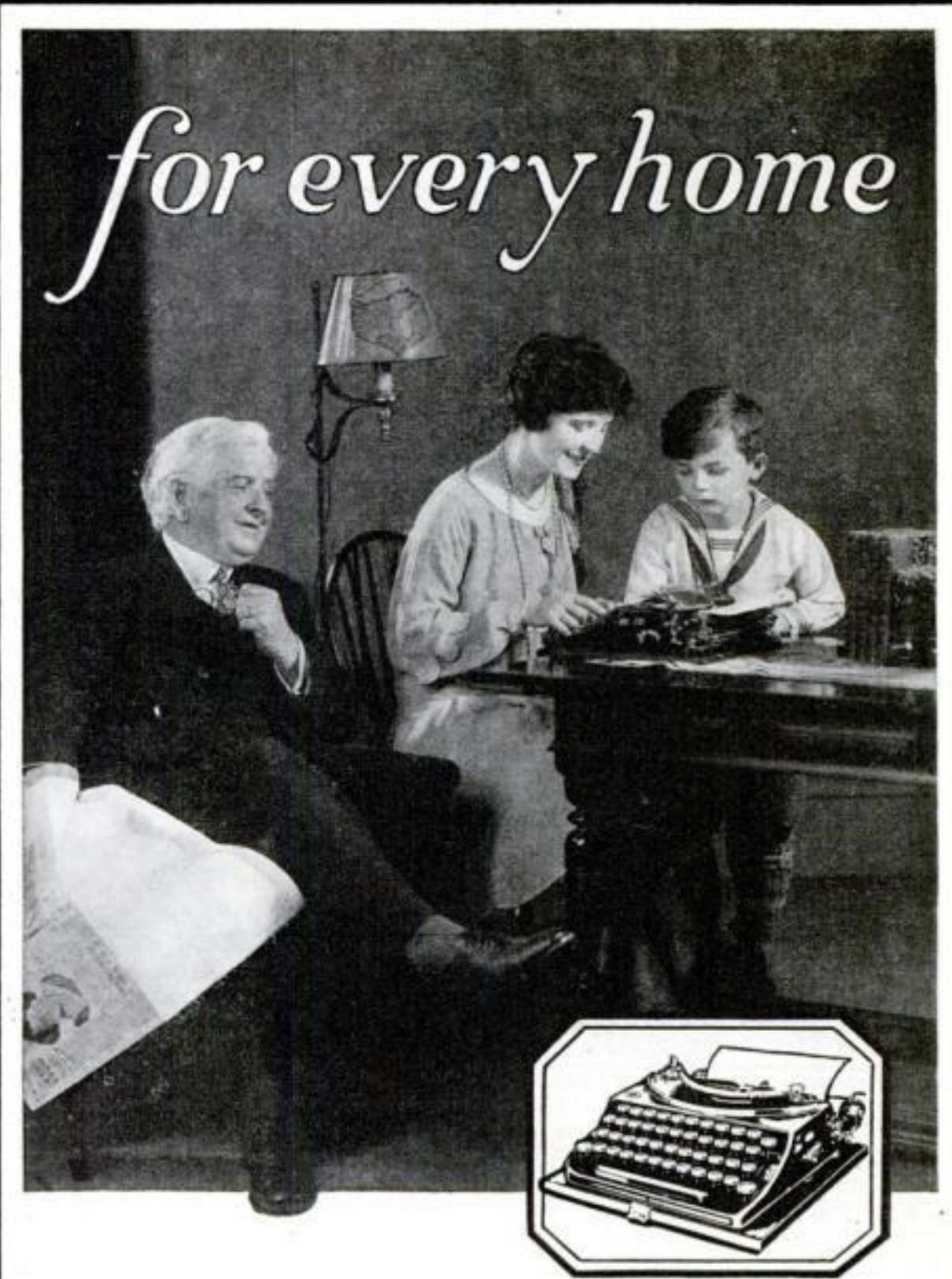
only weekly winding. Number 4 is a better clock, of course, and automatically retards the fire to night range. It may even be used to maintain a rising and evening temperature with a lower night and through-the-day temperature.

An ordinary alarm clock to control any installation, whether a thermostat is installed or not, is illustrated in Figs. 1 and 2. It was used here to control a converted vacuum cleaner, which accounts for the rheostat mounted on the panel—a slate shingle or other fireproof nonconductor. One or more lamp sockets, in parallel with each other but in series with the blower, may be used instead of the rheostat. Different combinations of lamps give the proper resistance to govern the speed of the blower. With a standard speed motor blower a switch only is needed. If a rheostat is purchased, one with six contacts having a range of 0 to 150 ohms will be satisfactory.

Figure 2 is the back of the clock. A hole is cut through the panel to fit the face and three small brass angles hold the clock firmly in position.

Wind the alarm key tight, forcing it to a convenient position so that a miniature toggle switch of the type corresponding to G. E. 1299, or its equivalent, may be mounted to engage with the key during its revolution when the alarm trips. Slight

(Continued on page 131)



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## What to Look For When Your Car Overheats

By RAY F. KUNS

"I CAN'T see why it should overheat," you will sometimes hear a car owner say. Neither can anyone else—at least, not literally. But if we begin to dig into the matter, we may find the cause of the trouble.

The hose illustrated, for example, appeared all right outwardly, but the lining had become softened and rotted.

Not all overheating troubles are due to the hose. Sometimes the radiator is clogged up, although it may appear pretty good and still allow water to pass through as fast as a hose will supply it. Usually this is due to the fact that part of the tubes are stopped up and the water is passing through those remaining open so fast that it does not have time to become cool.

It comes from the radiator almost as hot as it entered and goes back to the motor, which grows hotter and hotter. A new radiator is the only solution which is uniformly satisfactory.

Mud in the cylinder block is another cause of overheating. Have it removed.

Do not block up the normal air passages with a lot of equipment, such as camping supplies, and expect to escape trouble.

Butterflies, grasshoppers, bees and other insects have been known to fill radiator honeycombs to such an extent as to interfere seriously with the cooling. Dust and dirt accumulate in the radiator core. Take the hose and wash this out from the inside occasionally. Do not daub a lot of thick paint on the radiator core in an effort to "doll" it up.

We all know about keeping the fan belt in good condition and properly tightened, yet it is surprising how many forget about it until the engine is overheating. It is well to remember, too, that the fan blades can become bent out of shape and fail to throw the air properly.

Many an overheated engine has been produced by such a simple thing as a set hand brake or dragging foot brakes. Improper carburetor settings and poor ignition are contributing agencies in some cases. However, the troubles are more often in the nature of faults in the cooling system itself, usually in connection with the circulation of the water.



Hose cut to show how the lining has decayed

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## Better Heating

(Continued from page 129)

fitting of the toggle may be necessary so that it will clear the key. Install a radio switch stop or a 6-32 machine screw as a stop to prevent the complete unwinding of the alarm spring, making certain that it permits the full winding of the spring as well as the tripping of the toggle. Fasten the switch to the back of the clock by passing two 6-32 machine screws through the composition switch case in place of the short ones used by the manufacturer. A metal cover should be provided for the switch body to protect the switch wiring.

This switch, the resistance and the boiler thermostat visible below, if used, should all be wired in series with the live wire lead to the blower. All wiring must conform to the Code. The boiler thermostat illustrated is one of the 110-volt type mentioned in the first part of this article. The 110-volt room type, if used, is simply substituted for it.

If one prefers, the alarm key with no stop may be used to wind a string attached to a chain-pull light socket, the blower being attached to this socket by means of a drop cord.

To prevent too great a drop in house temperature at night where one of the 110-volt type thermostats are used, or the draft control

### CEILING

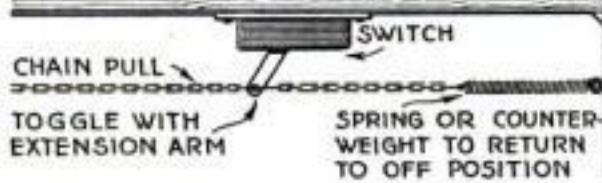


Fig. 4. Switch arranged for use with a control system of either spring or gravity type

without clock attachment, it is a good plan to connect a string by means of pulleys to the draft door and hook a loop in the end over the alarm key, when wound, so as to hold the draft door open. In this way the fire is left on natural draft throughout the night. When the alarm rings in the morning, the loop slips off, closing the draft door before the key trips the toggle switch. The fire left in this way will require a shorter time under forced draft to bring the house to 70 degrees than if left completely shut off. Only with the most exceptional draft will it burn noticeably through eight hours in this condition. A buckwheat coal fire when smothered with excess coal will keep 36 to 48 hours, but it will heat very little.

The instrument shown in Fig. 3 is the electric type draft control motor, in this case called a motor-program switch by the manufacturer because it contains a built-in 110-volt switch, which is operated by a cam and may be used to turn the blower on and off directly. This saves the installation of a separate switch, such as that illustrated in Fig. 4, which is necessary with other models.

The arms pointing up (Fig. 3) are attached by chains to the drafts, that on the right to the ash pit draft door, that on the left to the check. In the position shown the house is at 70 degrees, the check closed, the draft door open and the blower not running. In this way the fire tapers off under natural draft until the house temperature falls, when the living room thermostat will cause the motor to make one half a revolution, the arms then pointing down. The check will be open to give better combustion, the blower will be turned on, and the draft door will be closed to force the blower air through the fire. This cycle will repeat as necessary.

To use the thermostat for natural draft entirely, disconnect the blower and shift the lever arms one half turn. The motor may be mounted at any convenient point, with the chains passing through pulleys.

If a gravity or spring (Continued on page 132)

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**MECCANO**

## Better Heating

*(Continued from page 131)*

type motor is used, the chain which would normally open the draft door should be connected to the check draft as well as to a toggle switch. The author has seen a toggle switch made by one manufacturer with an extension lever arm. A spring or counterbalance should be installed to open the switch when the motor operates the control as the house reaches the correct temperature (Fig. 4). It may seem confusing to have these controls reversed, but the last paragraph explains. Except in the mildest weather no trouble will be experienced with overheating, because heat losses will compensate for the lag between house temperature and boiler heat.

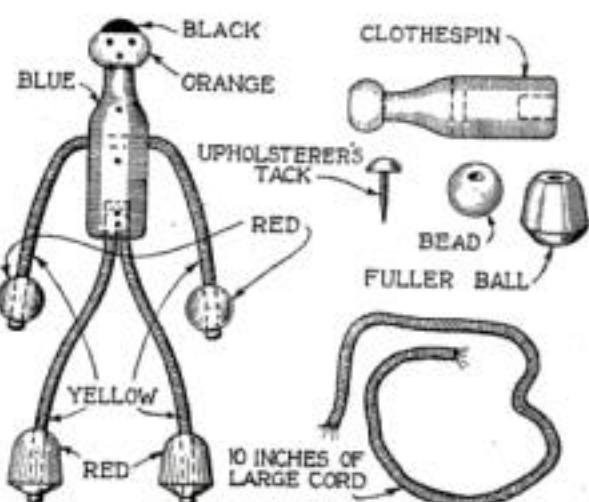
The switch below the motor-program switch in Fig. 3 is a special switch, called by the manufacturers an "electrolier" switch. It controls two circuits. The first snap turns on the thermostat circuit only, the second snap turns on the blower only, the third snap turns on both, and the fourth turns all off.

Number 1 will be used for natural draft only, after having shifted the lever arms; number 2, if the blower is ever wanted without thermostat control. Number 3 is the normal operating position, and number 4 is used when the system is shut down for the summer or if it is necessary to turn off the blower to remove ashes or start a fire. This switch controls the blower circuit in addition to the built-in switch or the toggle, if the arrangement shown in Fig. 4 is used.

From the author's experience he feels that he has obtained perfection in home heating—perfect control, perfect combustion, a fire that women can keep as well as a man with no more labor than adding a shovel of coal from two to four times a day, and at a cost which in comparison with any other heat is almost absurd. Two years' saving in fuel pays for this outfit and the saving each year thereafter is in cash, to say nothing of the increased comfort. Oil heat, of course, is ideal for those who can afford it; it has added conveniences but also added costs.

### "Comicull" Doll Has Clothespin Body

By F. CLARKE HUGHES



The completed doll with suggestions for coloring it, and the parts from which it is made

THIS "comicull" doll is an attractive little toy for the nursery. It can be made very easily and requires for materials only a clothespin, an upholsterer's tack with a large head, about ten inches of very thick white cord, two large beads, and two Fuller balls such as are sold for use in repairing faucets.

The clothespin is cut off and drilled as shown and the parts are assembled with glue. Bright waterproof enamel or lacquer colors should be used for decorating the doll.

## How to Repair Furniture

(Continued from page 98)

and pry off all you can. Loosen any veneer that sticks with a little hot water. Scrape the bottom of the cavity clean and flat and fit your patch. Fill a salt sack or even a sock with sand and, after gluing in the patch and covering it with a piece of paper, apply the sack, which will conform to the shape of the surface (Fig. 6, 96).

Face veneer sometimes becomes loose. Run a thin knife under the loose ply, freeing all the rough particles of dried glue that you can. Dip the knife in glue and push it under the raised veneer. Press the veneer down by rubbing it with a hammer head. Use a wet cloth to wipe off all surplus glue. Lay on a strip of newspaper and apply a pad of cloth and a pressure block, holding all with a clamp.

Sometimes face veneer will loosen and form blisters, as in Fig. 7. In the beginning these are usually of such small extent that the householder does not suspect their presence; but damp weather causes the thin veneer to swell and stretch. When you see a suspicious looking spot, press upon it with thumb or forefinger. If it depresses at all—springs up and down—the veneer is loose and needs immediate attention.

Using the small blade of your jackknife, cut cleanly through the middle of the blister, following the grain, as in Fig. 8. Dip the blade or a piece of tin in glue and force it under the blister, on both sides of the slit, as in Fig. 9. Then rub the surface with a hammer head and follow the procedure suggested above.

WHEN the job is dry, peel off the paper, dampen any spots of it that stick, and rub these places with the tip of the finger until the paper rolls off. A little light rubbing with a felt, wet with oil and pumice powder, will restore the finish.

The checking of furniture tops, drawer fronts, doors and panels is caused usually by atmospheric changes of a contrasting nature, although sometimes it comes from improperly kiln-dried lumber. If the check is short and close, try drawing it together with a clamp. If this works, put glue on a piece of tin or thick paper, and wipe the liquid into the check. Clamp it up again, wipe off the surplus glue, and, when dry, lightly rub the blemish with a felt pad wet with oil and pumice powder. If the check is quite narrow, but resists coming together under pressure, burn stick shellac into the cavity, and then rub down the surface.

Should the check be  $\frac{1}{8}$  in. or more in width (Fig. 10), make a thin wedge-shaped piece of wood or shive to fit it, and force it in with glue, pressing it down with the head of a hammer. Allow it to stick up a little (Fig. 11) so that you can shave off the projection when the piece is dry. Finish by staining the shive to match its surroundings and apply two coats of thin shellac or pale, quick-drying varnish, thinned fifty percent with turpentine. Rub the last coat.

In order to get the most telling effect out of your patching endeavors, I recommend your giving the entire cabinet finish a freshening up—a sort of rejuvenating bath. Furniture soon gets rather dull and lusterless, and a brightening of the polish now and then will make it seem like new.

One of the simplest and best cleansers is castile soap and water. Stir shavings of the soap in a basin of soft water until you have good suds. Dip a hand in the soapy water and with the palm rub the varnished surfaces circularly. After fifteen minutes remove the preparation with a soft cloth, rubbing briskly. This leaves a good polish.

Liquid furniture wax, if it is of first-class quality, is another excellent rejuvenator. Apply a thin, uniform film, let it stand about half an hour, and polish with a soft cloth.



## WHY MEN LEAVE HOME with half-clean faces

MOST fellows shave and bathe every morning, and yet go to work with half-clean faces.

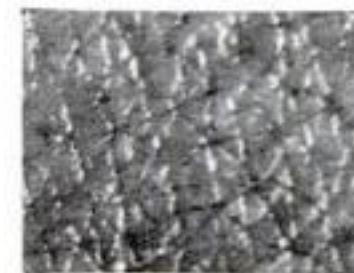
Pore-dirt hides in *every* face. Millions of tiny, grimy particles fly about in the cleanest air. You can't see them; they're too small—so small, really, that they get worked down *under* the skin.

After a while, pore-dirt gives you a grayish pallor . . . like a fellow who needs a vacation. "But I can't see any pore-dirt on *my* face," you say. That's because it's *in* your face, not on it. Here's proof:

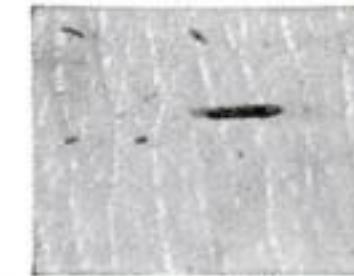
Send for the free tube of Pompeian Massage Cream. When it comes, first wash your face—then treat yourself to a quick, invigorating massage.

What happens?

**Goes in pink, ROLLS OUT GRAY . . .** The upper picture, taken under a powerful microscope, shows a section of skin *before* using



Photomicrograph taken under the lens of powerful microscope showing section of skin before using Pompeian Massage Cream.



Photomicrograph of the same section of skin after using Pompeian Massage Cream. Compare the skin tone. Note the dried pellets of cream, dark with the pore-dirt that has been rolled free.

Pompeian Massage Cream. Compare it with the lower picture, taken *after* using Pompeian Massage Cream. That's skin that really IS clean—Pompeian clean! See those dark marks . . . dried pellets of cream, gray with the pore-dirt that a few minutes' massage brought out.

And remember that imbedded dirt couldn't have been washed free in a month of Saturdays!

Give yourself a Pompeian Massage. Free your pores of sallow-toned dirt. It not only sets you up with a clean, confident feeling, but invigorates your skin with a fresh and ruddy glow that makes the others say, "Never saw you look any better, old man . . ."

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Pompeian is 60 cents at any toilet goods counter. We'd really rather you tested it FREE. Fill in the coupon and drop it in the mails—right now, while you are reading this message.

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MAKERS SINCE 1883

## STAR HACK SAWS



## New Methods of Traffic Control

*(Continued from page 30)*

problem is to keep the traffic moving. On Carnegie Avenue, one of our main thoroughfares, we have installed the Chronoplan of automatic traffic control through the operation of which system of signals motorists may travel the entire length of the street, about three and a quarter miles, without stopping. The time required for this distance is nine minutes."

Francis Smith, lieutenant of traffic, reports that Jacksonville, Fla., has overcome its greatest problems by signal lights, street-car safety islands, one-way streets and making all down-town thoroughfares forty feet in width.

Worcester, Mass., has, according to Chief of Police George H. Hill, established eighteen loading platforms for street car passengers so situated that vehicles may pass while the street cars are being loaded. "Also," he adds, "we have so synchronized our automatic signal lights that an automobile driver can make seventeen miles an hour through the main streets without stopping. Upon receipt of a fire alarm the chief, by pushing a signal button, can stop traffic in one or all three special fire zones, thus affording free passage for fire apparatus."

**I**N PORTLAND, Me., a Traffic Advisory Board, appointed by City Manager Harry A. Brinkerhoff, cooperates with the Public Works and Park Departments in effecting satisfactory traffic regulations. Among these helpful regulations, one marks the non-parking zones, and others the thirty-minute and one-hour parking zones.

Light signals, intense publicity for all accidents, full page safety-first advertisements and an annual Safety First parade reduce accidents caused by automobiles in Pittsfield, Mass., according to Chief of Police John L. Sullivan. With a trading population of 150,000, seven persons were killed in motor accidents during the year of 1925, but only three in 1926.

In general the larger cities have found that traffic troubles are more apt to come from lack of speed instead of too much of it; that when streets are widened, especially at bottle necks, the automobile proves a most satisfactory means of transportation.

All parking infringes on the rights of property and must, in time, be done away with; and also radial arteries and encircling boulevards must furnish the ultimate solution of city motor traffic problems.

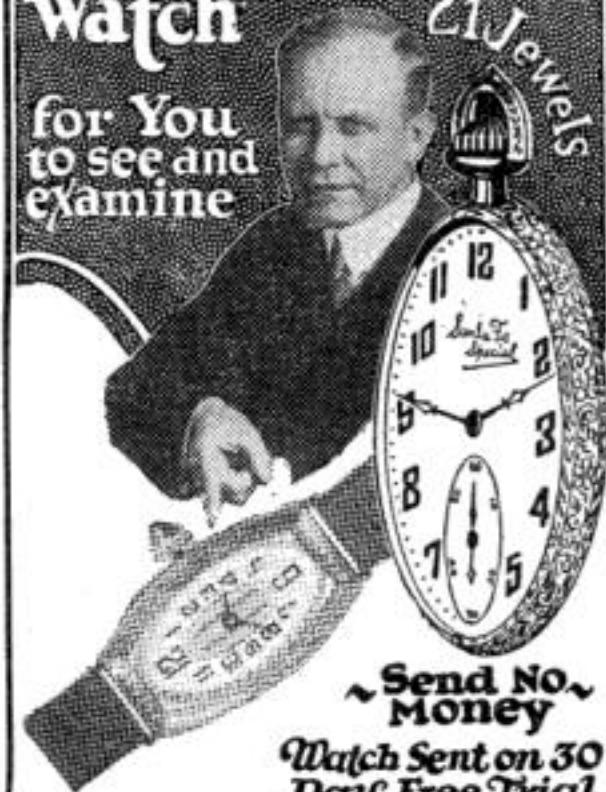
**I**N SMALL, outlying communities there is virtually no problem. For example, R. F. McLaren, assistant secretary of the Public Service Commission of Montana, reports, "The traffic density of Montana cities and towns has not reached proportions that are causing us any anxiety." From Provo, Utah, comes the reply, "As the city is small, the streets are wide and traffic not heavy and we have no traffic problems to speak of." And Calgary, Canada, advises through Chief Constable David Ritchie, "We have no traffic problem."

Tucson, Ariz., however, has found that it has to have strict regulations for its local and visiting motor cars.

About 25,000 Americans will be killed by motor cars this year, by conservative estimate. And as fifty-five percent of all registered cars are in cities of 10,000 population or less and only twelve percent in cities of five hundred thousand or more, the smaller as well as the bigger cities should begin to prepare for the 30,000,000 motor vehicles which within the next few years may be humming along our streets and roads.

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## Is Flying Really Safe?

(Continued from page 15)

A. Dargue, were killed, and Major Dargue himself escaped only by a parachute drop. These pilots were the pick of the Army Air Corps. Commander Rodgers, hero of the first Hawaiian flight and one of the most skillful pilots in the Navy, crashed and was killed landing at Philadelphia. The death-list among Army and Navy fliers is terrific. From July 1, 1922, to May 1, 1927, seventy-one Navy planes crashed, killing 116 aviators. The Army Air Corps, from July 1926, to May, 1927, had 158 crashes with 25 deaths.

Obviously, military aviation is not safe. To be sure, safety is not the main consideration in military flying, but does the public know the difference between the risks which the military aviator must take and those which the civilian pilot should avoid at any cost?

**WHAT** sort of flying is safe, then? Civil Aviation?

In the six years including 1921 and 1926 incomplete records show 849 civilian airplane accidents, resulting in 458 deaths and 598 persons seriously injured. Last year the deaths were seventy-five. *And the number of such accidents in 1926 was greater than in any preceding year.*

What sort of flying is safe, then, if any?

Last year, 1926, planes carrying the United States Mail on Government-operated air routes flew a total of 2,292,273 miles. In the same period planes on contract air mail routes flew 2,086,395 miles and carried several thousand passengers. In that total of 4,378,668 miles of flying, *there was not a single fatal accident.* In Germany, in the same year, 56,268 passengers were flown 3,814,000 miles over the Lufthansa airways with only one fatal accident; in Great Britain planes of the Imperial Airways flew 791,000 miles without a single fatality; in Australia more than a million miles was flown over regular routes without a death.

It seems, then, that there are conditions under which flying is reasonably safe. But to declare that flying is safe without pointing out that only one-twelfth of all the flying done in the United States in a year is done under conditions which make for safety, is to impose upon the credulity of the public.

**I**F IS as unfair to conceal or gloss over the dangers of aviation as it would be to tell a boy that ocean navigation is perfectly safe, without warning him not to try it in a canoe or a catboat.

Commander Byrd himself, G. M. Bellanca, Charles L. Lawrence, Clarence D. Chamberlin, Grover Loening and many other leaders in aviation and aerodynamics have declared against general air races and stunt flying. The responsible heads of the growing industry recognize that such contests as the Hawaii air race are a menace to the advancement of their cause.

"Stunt flying has noticeably stunted passenger-carrying aviation in the United States," says Col. Paul Henderson, President of the Aeronautical Chamber of Commerce. "Stunt flying is spectacular and dangerous. The general public could tell that. Hence the man on the ground, who was a potential passenger, was in many instances scared, and decided to wait and see, to let the other fellow fly first, before he will climb into an airplane. Hence, confidence in regular passenger service on established routes has been to a degree lacking, and unjustifiably."

Col. Henderson speaks with authority. As Second Assistant Postmaster General of the United States, he built up the Air Mail Service to its present efficiency; and as president of the National Air Transport, he heads the company which carries the Air (Continued on page 156)

# FAST LIFE WRECKS THE NERVES

**WE** are living in the age of SPEED, the mile-a-minute life. We crowd two or five years of life into one. We hurry; we worry; and we dissipate, little realizing that there must come an end to our supply of Nerve Force—that we will become nervous wrecks—Neurasthenics.

There are countless "near neurasthenics" about us everywhere—in the streets, in the cars, in the theatres, in your business, and especially in your own home—right in your own family.

"Nerve-weakness" is not a malady which manifests itself, as many people believe, in twitching muscles, trembling hands. These conditions are found only in advanced cases.

There is but one malady more terrible than Nerve Exhaustion, and that is its kin, Insanity. Only those who have passed through a siege of Nerve Exhaustion can understand the true meaning of this statement. It is HELL; no other word can express it. At first the victim is afraid he will die, and as it grips him deeper he is afraid he will not die; so great is his mental torture. He becomes panic-stricken and irresolute. A sickening sensation of weakness and helplessness overcomes him. He becomes obsessed with the thought of self-destruction.

The symptoms of nerve exhaustion vary according to individual characteristics, but the development is usually as follows:

**First Stage:** Nervousness, restlessness, sleeplessness, lack of energy, poor circulation, and other minor symptoms of low vitality.

**Second Stage:** Nervous indigestion, belching, sour stomach, gas in bowels, shallow breathing, decline in power of the reproductive functions, high or low blood pressure, hot or cold flashes, heart palpitation, mental uneasiness, irritability, undue worry, despondency, self-consciousness, etc.

**Third Stage:** As nerve weakness advances, the symptoms mentioned before become more severe. It is then the more severe mental symptoms appear; namely fears, melancholia, dizziness, loss of memory, hallucinations, suicidal thoughts, and finally INSANITY.

If only a few of the symptoms mentioned here apply to you, especially those indicating mental uneasiness, you may be certain that your nerves are weak and deranged. Fight this weakness as you would fight for your life. **Conquer it, or it will conquer you.** There is nothing more terrible than Nerve Exhaustion.

### Medicine Useless

Medical treatment for nerve weakness is worse than useless. Taking drugs to stimulate jaded nerves is like making a tired horse run by dragging him behind an automobile.

### Physical Exercise May Be Harmful

Don't be deceived into believing that some magic system of exercise will restore lost Nerve Force, as is so often claimed by physical culturists. More often it wastes the little that is left, for exercise demands expenditure of Nerve Force. Bear in mind that some of the worst nervous wrecks may



PAUL von BOECKMANN

be found right among our physical culturists, prize fighters and noted athletes. Nerve abuse wrecks the strong as well as the weak.

### Important Book on the Nerves

Many excellent books have been written on the care and strengthening of the nerves, but by far the most practical book ever written for the benefit of the general public is "Nerve Force" by Paul von Boeckmann, the noted authority on this subject, who has for thirty years made an intensive study of people with weak and deranged nerves. The book is illustrated and contains 64 pages of condensed facts and advice upon the subject of Nerve Culture. The cost, prepaid, is only 25c. (Coin or small denomination stamps).

### Your Children's Nerves

This book is of inestimable value to parents. Proper care of a child's nerves is as important as his mental training, for education is of little value unless backed by sound nerves.

Nervous parents are likely to beget nervous children. The information contained in this book will give a parent a thorough understanding of the dangers that threaten a child's nerves and how to counteract them, so that the child can become immune to nerve strain and become strong and healthy.

### Unconditional Guarantee

This book is guaranteed from cover to cover. If after applying the advice it contains, your nerves do not feel 100% calmer and better, your money will be refunded PLUS your outlay for postage. There is no time limit to this offer.

Over a million copies have been sold, a record never before reached by any other book on health. This book and several other books on health subjects by the author are now on file in many public libraries and at the National Medical Library at Washington, D. C. They are highly recommended by noted physicians, scientists, teachers, ministers, and students of health culture.

### What Others Say:

A prominent lawyer in Ansonia, Conn., says: "Your book saved me from a nervous collapse, such as I had three years ago. I now sleep soundly and am gaining weight. I can again do a real day's work."

A physician says: "Your book shows you have a scientific and profound knowledge of the nerves and nervous people. I am recommending your book to my patients."

A mother writes: "I always had that dragged out feeling. I could not take any interest in my children's activities; they annoyed me. I could find no relief until I read your book. It taught me how to build up my nerves. Now I am a companion to my children, can play with them, and am interested in their doings."

A college student writes: "I studied so intensely to pass my 'exams' that I broke down completely, and had to leave college. After following your teachings, I was able to return to school and complete my education, graduating with honors."

A young girl writes: "I have been suffering from depression for a long time. I tried many cures, but none succeeded. In changing my mental attitude to life, you saved me from this terrible melancholy."

An athlete says: "To look at me, you would have thought me to be 'the picture of health.' But my appearance was deceiving—I was strong physically but internally my nerves were shaky and life was a burden to me. Now I understand that muscle isn't everything."

A business man writes: "Your book did more for me for indigestion than two courses in dieting."

Fill in the attached coupon today—NOW. The book will be a revelation to you.

Paul von Boeckmann, Studio 1430, Cellini Bldg., 48 W. 48th St., New York City.

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## Is Flying Really Safe?

(Continued from page 135)

Mail from New York to San Francisco. Incidentally, the only plane which got through to Hawaii without trouble was of the same type of those which his company uses.

It simmers down to this, the question of whether flying is safe.

Over regular routes such as those flown by the Air Mail, adequately lighted all the way, with lighted emergency landing fields so close together that a forced landing can be made with safety at any time and with radio direction equipment, flying in a plane of one of the four or five first-rate commercial types, properly inspected and licensed by the Department of Commerce, and with engines of equally high standards, piloted by a licensed transport pilot, the passenger takes no greater risk than he does in traveling between New York and Chicago by rail—keeping in mind the fact that passengers have been killed on the trains. No other kind of flying has any right to be called safe.

THE day will come, we believe, when the Government license on a plane, and the Government's license in the pilot's possession, will mean that anybody who takes passage in that plane and with that pilot is taking no undue risk so long as he does not fly out of gliding range of a proper landing field. It does not mean that today. The Department of Commerce, perhaps wisely, is interpreting the Air Commerce Act "liberally." The regulations should be tightened up. Cheap planes, left over from the war or copied from obsolescent types, equipped with inadequate war-time training engines, should certainly not be licensed for passenger service of any kind.

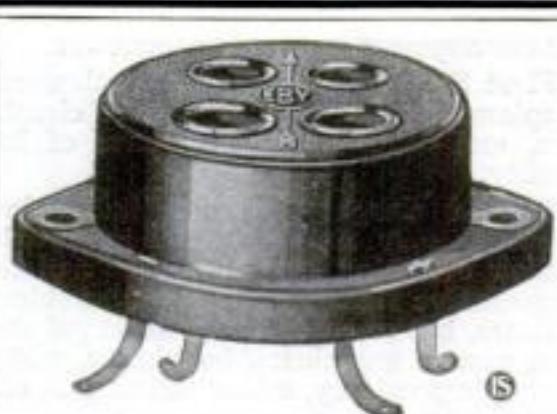
Unfortunately, the Government has no control whatever over private planes and private pilots. Unless a plane carries cargo or passengers for hire across state lines its owner and pilot can laugh at Uncle Sam and go merrily on their way, continuing to demonstrate that flying is not safe. More than half of the fatal flying accidents are due to incompetence, inexperience or foolhardiness on the pilot's part. The French Government last year analyzed flying accidents as to causes, by percentages. Fifty-four percent of all crashes, 62 percent of fatalities and 63 percent of injuries were the pilot's fault. Failure of planes or equipment caused 11 percent of accidents, engine trouble 22 percent, bad weather 5 percent, and various other items the remaining 8 percent. Our Department of Commerce's licensing requirements for pilots seem rigid enough, as far as they go; and they go as far as the Federal Government has power.

It is time for the states to set up a few restrictions of their own, as New York and one or two others have done. Pending such restrictions, it is up to the man on the ground, to stay on the ground if he values his life, except under the ideal conditions such as the Air Mail services offer.

The best evidence that aviation is not safe is found in the offer of \$150,000 in prizes by the Daniel Guggenheim Fund for a "Safe Aircraft" competition. These prizes, the largest one of \$100,000, will go to the designers and builders of planes which can do things which no plane in existence today can do. The prize winners must be able to fly at lower speeds, rise with a shorter run, land in smaller space, climb more steeply on the take-off, glide safely at steeper angles, maintain greater stability in flight, recover more certainly from abnormal air conditions, be more easily controlled and maneuver more readily in restricted territory and on the ground than anything which has yet been built. Those conditions summarize the defects which experts and scientists recognize in the airplane of today, defects which make the statement that "flying is safe" seem foolish.

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## Driving—Dozing—Death!

(Continued from page 69)

you had time to reason out all that Sherlock Holmes stuff. Why, it couldn't have been more than a few seconds from the time you first blew your horn till the crash. How did you dope it out so quick?"

The veteran smiled. "Blessed if I know," he said, "unless it's because I've been driving so long. Quick thinking and being able to figure out the right thing to do in an emergency are things that you can get only by a whole lot of driving. No instructor can teach it to you. And as for that sleep stuff, I'm always on the watch for it. I nearly got killed myself years ago by dozing off while driving."

"Of course there's no way of getting accurate figures, but most people have no idea what a large number of accidents are due to the driver falling asleep. Most of the fellows who fall asleep while they're driving and get into an accident either don't realize what happened or if they do they are ashamed to admit it."

"SLEEP is a mighty queer business anyway," Gus went on. "Sometimes when you want to go to sleep you can't, and then when you ought not to, you do."

"But why," asked Joe, "should a fellow who has trouble in getting to sleep even when he's in bed be likely to go to sleep when he's driving a car?"

"I didn't say that," replied Gus. "The fact that he doesn't sleep well nights has nothing to do with it. It all depends on how easily he is affected by monotonous sights and sounds. When you're driving along a straight road for miles and miles the steady hum of the motor combined with the comfortable position and the lack of physical motion seems to lull your senses into a drowsy state. Of course, in heavy traffic where you are constantly forced to apply the brake, shift gears and steer the car, you may get tired but you won't get sleepy."

"If you want to find out how hard it is to keep awake some time," Gus went on, "just ask one of the fellows who did sentry duty during the World War. Even the certainty of facing a firing squad in the morning if they fell asleep wasn't enough to keep some of them awake, and if I remember correctly Charlie Lindbergh claimed that he was more afraid of going to sleep than anything else on his hop across the ocean."

Back at the garage an hour later, they found the victim of the sleep accident curled up on the front seat, snoring peacefully.

"Might as well let him snooze while we work," Gus suggested, but the pounding soon woke the sleeper and he climbed out to watch.

"You can bet I won't go to sleep at the wheel again," he said.

"How are you going to prevent it—by giving up driving?" Gus asked as he pulled the end of the new spring into line.

"CERTAINLY not!" replied the owner peevishly. "I haven't got cold feet yet. I'll just remember not to go to sleep, that's all."

"Banana oil!" snorted Gus. "Will power will help, of course, but it's a whole lot better to adopt some definite way of overcoming the sleepiness. About the best I know of is one that a salesman friend of mine works when that sleepy feeling creeps over him. He pulls up at the side of the road out of the way of the traffic and deliberately goes to sleep for ten or fifteen minutes."

"Then I know another fellow that gets out and runs up and down the road a bit. The exercise, he says, starts the blood circulating and seems to break the hypnotic spell brought on by the steady hum of the motor."

"If you're going to stop anyway," suggested Joe, "why not park at a hot dog stand and eat one while you're waking up again?"

"Humph!" growled Gus. "That ought to work—indigestion will keep anybody awake!"



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## Driving Motor Cars to Death

*(Continued from page 25)*

that you would want your new car to receive after the breaking-in.

Now for the tests. First, fuel consumption. Filling the gas tank to the brim, they drive at twenty-five miles an hour, recording the number of miles made before the tank is empty. Similar runs at twenty-five, thirty-five, forty-five and fifty-five miles determine oil consumption.

For a detailed record of the car's fuel economy at various speeds, they mount a specially devised gasoline gage on the dash. This consists of a glass tube, or burette, graded in cubic centimeters and connected with the supply so that it reveals minute changes in the fuel level as the car proceeds. The tester sits beside the driver with the gage before his eyes and a stop watch in his hand.

**N**EXT, speed and "pick up," or acceleration. Knowing that the ordinary speedometer in common use never can be depended upon, the experts have devised a "fifth wheel speedometer," which has proved extremely accurate.

This is a bicycle wheel mounted at the side of the car and resting on the road. As it revolves it drives an electric generator. The record of the amount of current produced by the generator is a measure of the car's speed.

Seventy-five miles an hour is about the limit for most modern automobiles. At least two of the latest models, however, have passed the hundred-mile mark.

Low speed as well as high is an important item. The testers determine how slowly the car can travel and still be managed easily, and the lowest speed at which the engine will idle without stalling.

Acceleration is recorded by the speed attained at specified distances and by the time taken to advance from one rate of speed to another.

For tests of acceleration in low and intermediate gears, the car is stopped at the foot of a hill and started from rest.

In the hill-climbing tests the easiest hill is a 7.26 per cent grade—about as steep as you are likely to encounter on the highway. Next comes 9.7 per cent, then 11.6 per cent—a hill rivaling the famous Uniontown Mountain in Pennsylvania.

On each hill the driver puts a car through tests with a running start at ten miles an hour, then twenty miles, and finally thirty, recording the speeds at various points along the way, as well as the total time to reach the summit.

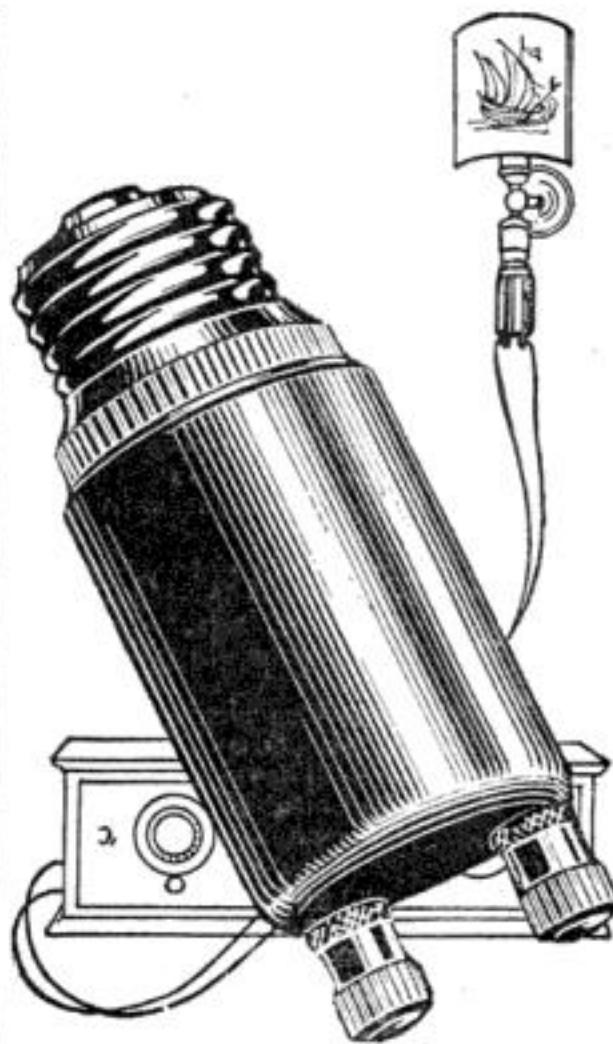
**A**ND if the car breezes over the tops of the three hills without sign of faltering—there remain still greater challenges to its power; grades of 21, 24, and even 35 per cent—the next thing to a precipice.

Moreover, Pike's Peak or any other grueling climb in the world can be duplicated with amazing exactness on a level stretch of Proving Ground road, by the use of an electrical machine called the "towing dynamometer."

This is a trailer carrying an electric generator driven by the movement of the wheels. An electric resistance connected with the generator can be varied to produce any load or pull desired when the trailer is hitched to the car under test.

And, as has been proved by making a great number of tests, the performance of the car can be measured accurately from the amount of current produced by the generator. The men at the Proving Ground call this machine "The Thousand-Mile Hill."

Steep hills and dynamometers play an equally important role in the next test—for braking efficiency. First, to test the four-wheel brakes the driver runs the car up an incline onto a set of four roller (Continued on page 139)



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**Dubilier**  
CONDENSERS

## Driving Motor Cars to Death

(Continued from page 138)

bearings. One wheel rests on each roller. When the car is started under its own power the rollers revolve, each driving a generator. From the record of the current produced, the tester can calculate the horsepower transmitted through each wheel, and the effectiveness of each brake at various pedal pressures.

For a further road check on these measurements, the driver next takes the car down the hills. In each of several trials, he lets the machine roll down until it attains a determined speed, then steps on the brake pedal while the tester records the distance the car travels before it comes to a stop, the time required to stop, the rate of deceleration, or slowing down, and the effort expended by the driver's foot on the pedal.

Because the brakes are perhaps the most vital part of the car, so far as driving safety and comfort are concerned, the engineers have developed extremely accurate instruments to measure their efficiency. To record deceleration, for example, they employ a delicate mechanism based on much the same principle that causes a railroad passenger to lurch forward in a car when the train comes to a stop.

Instead of a human body, however, the device contains a moving weight. Its motion as the brakes are applied writes a picture of the deceleration on a moving roll of paper.

Again, to measure the pedal pressure required to stop a car at a given rate of speed they have devised a sort of stirrup attached to the brake pedal.

The driver places his foot in the stirrup, which records the pressure through a spring mechanism. The same device measures the energy required to operate the clutch.

EVERY man when he buys a car these days, of course, is as much concerned with its riding qualities as he is with its power and speed. For these the Proving Ground experts have invented surprising tests.

Most spectacular is the "bath tub," a depression in the concrete roadway filled with water axle deep. The car comes sailing along at twenty-five miles an hour. Splash! In she goes! The spray flies high all about us. Will she stall? Or will she be able to paddle through to the other side of the pond? It doesn't take long to find out.

Back on the dry road they examine the machine inside and out. If the body or windshield leaks, they make a note of the fact. Examination reveals whether the water affects the ignition system or brake linings of the car; whether it gets into the carburetor; whether the fenders are set at the proper angle to shed a flood, and so on. Sometimes the testers even go so far as to fill the "bath tub" with mud instead of water, just to see how much mud will splash over the body and chassis.

After the bath, they set to work to find out exactly how much noise the car makes at various speeds as well as the amount of vibration in engine, chassis, axles, steering gear and driving and passenger seats. Radio amplifying apparatus gives an electrical record of noise, while vibration writes its own record on special paper tape.

A drive over rough roads reveals much about comfort and the ease with which the car can be handled. The tester rides in one seat, then another, comparing their comfort. This record, of course, is a matter of judgment by a trained expert who has traveled in thousands of machines.

Next the expert assigned to the job observes the amount of wobble or "shimmy" in the front wheels as the car travels at top speed; also the steadiness of steering over the rough going. The actual amount of energy which the driver must use in handling the steering wheel is determined

(Continued on page 140)

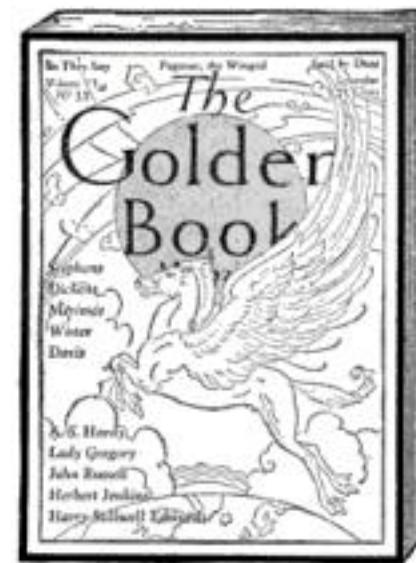


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The stories that deserve to live, the worthwhile works of literature combine vigor of thought with beauty of style and artistic construction, and like ships sail on through the years. Trash is as ephemeral as the waves of the sea.

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**WARD LEONARD**  
ELECTRIC CO.

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## Driving Motor Cars to Death

(Continued from page 159)

by a device consisting of a duplicate wheel attached to the steering post and containing a mechanism which accurately records the pounds pressure exerted in turning it at the various speeds.

There remain the questions of how much time and labor the prospective owner must expend in caring for the car, and how many small troubles it is likely to cause him. And so, while mud and dirt are still thick upon it, the driver takes it to the garage for an entirely new examination.

Here the tester, holding a stop watch, records the time it takes to wash, polish, grease and oil the machine; also the time to change tires with the tools that are supplied by the automobile maker.

Other tests which are considered necessary in proving a car are made to determine such items as efficiency of headlights in road illumination, accuracy of the dashboard instruments, convenience of these instruments for observation, amount of windshield reflection, accumulations in oil and gas filters, the charging rate of the battery.

**A**PPPEARANCES, too, count mightily with car owners. Therefore this and every other car, like a blooded stallion at a horse show, must pass by for inspection. The fit and finish of its hood, fenders, running board; the paint on its body; its upholstery, floor covering, hardware, accessories—all these fine points are carefully noted. Even the slopes and curves of its lines are charted. For this the car is placed in front of a background ruled in squares and there photographed. Film transparencies of the photographs then can be compared with those of other models, revealing differences in wheel base, height of body, length of hood, size of windows and doors, and so on. In this manner designers can analyze motor car fashions and gage the trend of public demand upon appearances.

You might think that after an automobile had undergone such a thorough dissection, the engineers would be satisfied. Actually, though, the tests have just started! The long grind, the test of time, is still ahead. Once more the driver who is to make the test climbs behind the wheel and urges the machine out over the Proving Ground roadways.

Week in and week out, the car jogs along for hundreds and thousands of miles. It travels in the course of this journey at a wide range of speeds, duplicating, as nearly as possible the speeds at which a typical motorist would be likely to travel. After each 5000 miles the first engineering tests are repeated.

**M**EANWHILE whenever the car requires repairs or adjustments, it goes into the shops. If any part breaks or becomes defective, a new one is substituted, and the defective part is sent to the engineering laboratory for analysis and study.

Every item of repair and every replacement is charted on a large scale bulletin board, which thus tells at a glance which portions of the car require attention most frequently, and at what mileages they invariably will demand it.

At 25,000 miles the machine is considered to have written the complete history of the best years of its life. Its strenuous days on the Proving Ground are ended, and it passes into the realm of used cars.

Its autobiography, however, remains as a permanent record, serving as a basis for comparison with contemporaries, aiding in establishing standards by which all motor cars can be rated, and supplying a starting point from which engineers can remedy the weaknesses of the present in the automobiles which you and I will drive tomorrow.

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## "I'm Going to Raise My Boy to Be a Plumber"

(Continued from page 11)

and professional experience, the engineer can look forward to what a photo-engraver, a printer or a skilled lather can make as soon as he is in the journeyman's class.

But here we come to the second argument which encourages the flood of youth to college. This same investigation by the Society for the Promotion of Engineering Education shows, as do studies made in large industries employing many men of all types, that the college graduate doesn't stop at \$4,000 in ten years. He keeps going up in pay—overtakes and leaves behind the noncollege man.

Does this mean that the college education is belatedly "taking?"

He may believe so. But I believe—as do two college professors whom I found making vocational studies along this very line—that the type of man who goes through college is bound to forge ahead anyhow. I might even argue from the figures that it takes him ten years to overcome the handicap of his cloistered college life.

THE salary is earned by the man every time, and not by the college education. Of that fact, at least, the statistics offer evidence. If there's specific money-earning power in a college degree, why are the minimum earnings of engineering graduates around \$3,000 thirty years after graduation when the maximum is over \$30,000? Why aren't they approximately the same?

Chiefly because the *men* are different.

Likewise, the college graduates as a group are different from the rank and file of noncollege men whom they outdistance. But the difference doesn't consist in the possession of so many units of text-book learning and one A.B. degree. The difference is in economic privilege and in native ability. It is estimated that out of a thousand pupils who start first grade in the elementary schools this fall, only 300 will enter high school, only thirty-eight will get as far as college and only fourteen will finish college. Thus the college graduate has had enough financial backing and native intelligence to survive sixteen years of continual selection.

The educational process has not necessarily given him something that others lack; it has weeded out others who lack something that he has—namely, the sort of initiative, intelligence, grit and determination to accomplish set tasks which would make him a large money earner, anyhow, whether he acquired his schooling in college halls, in the streets, in the machine shop or the railroad yard.

AND those of us who have these qualities, but are weeded out of educational system by economic pressure, can come to the top also.

In certain large industries 85 percent of the men who earn more than \$3,000 are noncollege men. In certain mechanical branches of American industry, 73 percent of the men earning over \$5,000 reached that level without the help of a diploma.

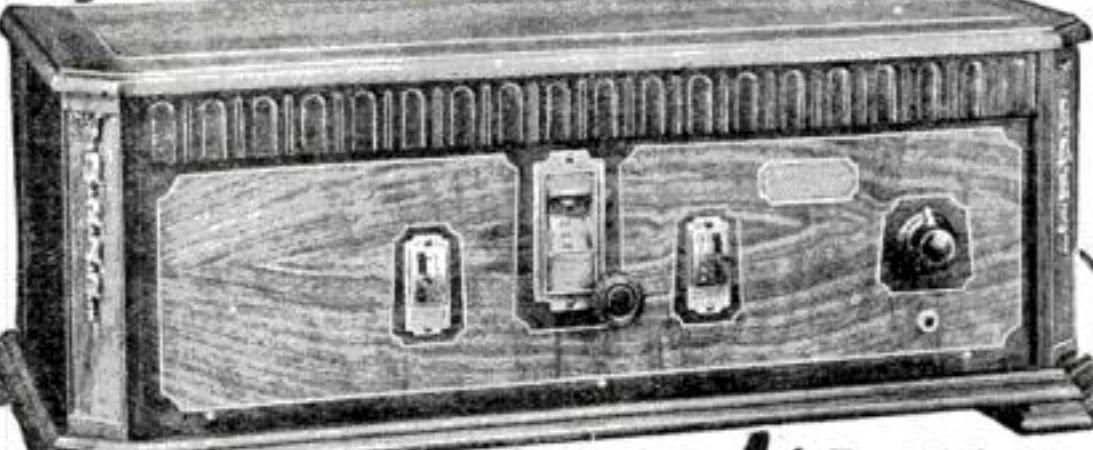
The employment manager of a large company told me:

"Below our executive positions, the white collar workers are not so well paid as the skilled manual workers. The latter have an excellent opportunity to rise into supervisory jobs at good pay. In our business there will always be, at any age, several noncollege men farther ahead in rank and salary than any but perhaps one outstanding college man."

An important manufacturing company reports that 40 percent of those who started as apprentices twenty years ago are still with the organization, and half of these are in supervisory jobs.

Take the Class 1 railroads, America's largest employers of labor. (Continued on page 142)

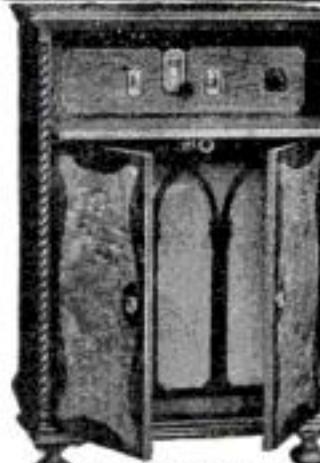
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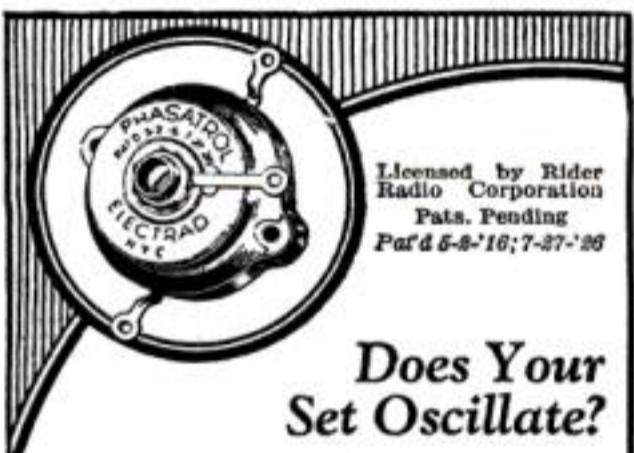
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Your radio will be a far greater pleasure with oscillation noises eliminated. Phasatrols suppress oscillations and their accompanying disturbances to reception. Designed for use with most R. F. Sets—very easy to install.

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Magnet coils wound around bakelite bobbins with wire, coated by a substance, which a year's research in the Crosley laboratories developed, keeps the Musicone con-

stantly efficient in any climate.

A new metallurgical discovery increases the vibrations of the patented actuating unit 10 times over the former type, even then superior to anything on the market, with resultant sensitiveness to delicate tones, increased smoothness and finer and greater volume.

If you cannot locate your nearest dealer write Dept. 17 for his name and literature.

**THE CROSLEY  
RADIO  
CORPORATION**  
Powel Crosley, Jr., Pres.  
Cincinnati, Ohio

## "I'm Going to Raise My Boy to Be a Plumber"

(Continued from page 141)

A survey made by a subcommittee of the American Society of Mechanical Engineers brings out such facts as these:

Out of seventy-nine railroad presidents, forty-five rose from the ranks without college training. An analysis of a group of other officers showed the following proportion of noncollege men:

Vice Presidents, 52 percent  
General Managers, 83 percent  
Superintendents of Motive Power, 56 percent  
Mechanical Engineers, 20 percent  
Master Mechanics, 80 percent  
Need the noncollege man resign himself to a subordinate position forever?

**B**ILL HINKLE, who went into the round house when Freddy Vail went to college, has a fair chance of climbing to the job of superintendent of motive power with a salary of \$10,000 or more at the age of forty-eight.

Government figures show approximately 65,000 railroad engineers earning an average of \$245 a month; approximately 23,000 skilled foremen averaging \$237 a month, while 26,000 white collar workers below the officers but above ordinary clerks average \$217.

What price a white collar job?

I asked that question of a man who knows the building trades well and whose handiwork is to be seen among modern New York skyscrapers.

"I can hire in our drafting room," he said, "college graduates to work at \$40 a week on plans for a building that will be put up by structural iron workers at \$14 a day. I can hire accountants whose college diplomas are worth \$45 a week; but I know skilled lathers who can make \$15 or \$20 a day."

When plumbers, carpenters, painters and electrical workers are getting \$12 a day—when bricklayers and plasterers are getting \$14 a day—the answer to your question is obvious.

"In my own college class, of fifteen men with whom I have kept in close touch, only four have approached \$5,000 salaries in fifteen years. The majority of them are making no better money than good foremen can average in the well-paid trades. And four of them are earning under \$2400 a year in white collar jobs where they have no future."

I hunted up a prosperous contractor.

"It's bunk," he declared, "to make the sweeping assertion that the skilled manual worker will get stuck at a certain level if he hasn't a college training. I started as a mason. I didn't get stuck. A live man in the building trades can rise to foreman and make \$3400 to \$4,000. He may become estimator and make \$80 or \$100 a week. As superintendent he may get \$5,000 or \$8,000 a year. If he's smart, he'll finally go into business for himself and make anywhere from \$10,000 a year up. It's the white collar worker who gets stuck. He's likely to be an employee for life, in a blind alley job."

**T**HIS contractor made two points that I have encountered again and again in discussing this subject.

"First," he said, "don't forget that the boy who takes up a trade must be able to face rough, back-breaking labor. But secondly, the man with a good physique plus the sort of brains that would take him through college can rise far and fast. I wish I could have on some of my jobs a few college-minded men. I did have one—and now he's one of my competitors."

Said an electrical worker:

"I can afford to send my boy to college, but he doesn't want to go, and I'm not urging him. His cousin went to college and now he's in a bank. When my son George is in the contracting business for him—

(Continued on page 143)



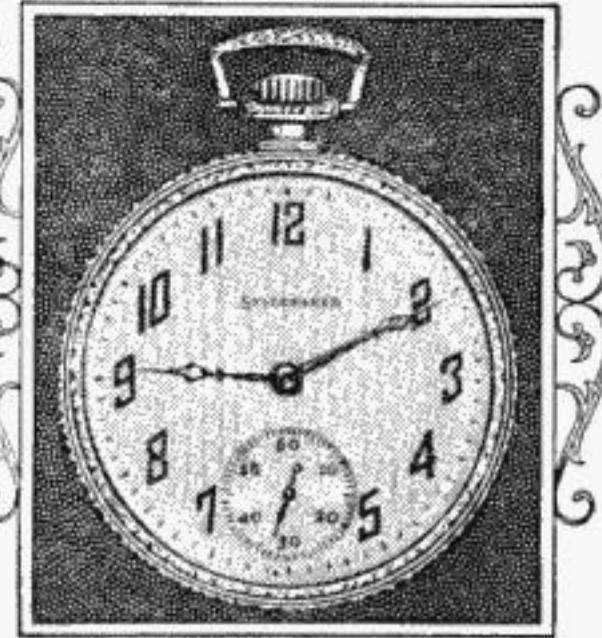
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An amazing offer! Just \$1.00 down brings you the famous 21 Jewel Studebaker Watch direct from factory. Balance in easy monthly payments. You save fully 30% to 50%. Lowest prices ever named for equal quality. Send coupon below for catalog of Advance Watch Styles and full particulars.

This amazing offer enables you to pay for your watch while wearing it. Studebaker Watches have 21 Jewels, genuine rubies and sapphires, 8 adjustments—for heat, cold, isochronism and five positions. Insured for your lifetime! Insurance Policy given FREE! Ladies' Bracelet Watches, Men's Strap Watches, Diamonds and Jewelry also sold direct to you at lowest prices and on easy monthly payments. Open a charge account with us. Send the coupon.

#### WRITE for FREE CATALOG

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#### Special Limited Offer: Watch Chain Free

For a limited time we are offering a Magnificent Watch Chain Free. To all who write immediately we will include particulars of this astounding special offer. This offer is limited. Send the coupon at once—before it expires.

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and details of your \$1.00 down offer.       Please send me free  
catalog of Jewelry and  
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### New Vitreous Enamel Resistors



Wire wound, protected with hard glassy enamel. Enamel and wire have a small rate of expansion, permitting safe operation at high temperatures. Cannot oxidize. Guaranteed permanently accurate within 5% of rated value.

In Canada, Carter Radio Co., Limited, Toronto

MEMBER  
RMA

Carter Radio Co.  
CHICAGO

## Answers to Sam Loyd Puzzles on Page 66

### A Rebus Remedy

The physician's puzzling advice should be deciphered in ten minutes to read: Decay follows excesses.

### A Puzzling Key Ring

The janitor's arrangement of his keys in three groups so as to present such numbers that the third would be the product of the first and second follows: 78—345—26910. The problem should be solved within fifteen minutes.

### What Was the Age of Fido?

If we let X stand for Fido's age five years ago, then sister's age (being four times older, or five times as old) would be represented by 5 X. Adding five years to each, 5 X plus 5 represents sister's age and X plus 5, Fido's. They are now in a ratio of 3 to 1, from which we deduce the equation, 3 X plus 15 equals 5 X plus 5. The solution gives us the value of X as five years. Today, Fido is 10 years of age and sister must own to 30 years. Five minutes.

### Trading Livestock

Hank had eleven animals; Jim had seven; and Duke, twenty-one. Nine minutes.

### A Test for Nimble Wits

The natural way of tackling that chain-cutting job would be to cut every fifth link and so separate the thirty-link piece into six five-link pieces. That would necessitate six resolderings as well as six cuttings, and the job at the prices given would cost \$1.50. However, there is a less expensive way of producing the six pieces from the circlet—at a total cost of only \$1.25. This is to cut and take out every sixth link, thus producing five complete five-link pieces and five single links, which have been cut through. Five cuts and five weldings thus are sufficient, rather than six of each by the other plan. Five minutes.

### A Mystifying Race

It would be a tie if it were a straightaway race; but in running to the stake and back, each half of the race would be 112½ feet, and the dog would have to make twenty-three leaps in either direction, thus going a distance of 230 feet. The cat would go over and back in seventy-six leaps, a distance of 228 feet. Since they raced at like speeds, Tabby would finish two feet ahead of the dog. Ten minutes.

### Solving Auto Engine Secrets

MOST of us take it for granted that the development of the automobile has about reached its limit. As a matter of fact, though, engineers say they are only at the beginning in working out the fine points of improvement.

They are just beginning to learn, for example, what happens inside an automobile engine. The other day Dr. Emma P. Carr, of Mount Holyoke College, announced before the Institute of Chemistry of the American Chemical Society that spectroscopic investigations in progress might reveal the nature of the explosions inside the cylinders and solve the mystery why "knock" preventers such as ethyl gas increase engine efficiency. These studies, she said, already have shown that detonation, as compared with normal explosion in the cylinders, represents a decidedly different type of chemical reaction.

Further knowledge of the mysteries of combustion will enable automotive engineers to design motors of greater power and less fuel consumption.

## Here Are Correct Answers to Questions on Page 53

- As you travel on a railway, through northern Nevada, a glance at the sides of the mountains will disclose long, level benches or terraces. Geologists have proved that these terraces really are the abandoned shore lines of lakes that have dried up.
- Lake Superior is, strictly speaking, the largest fresh-water lake in the world, with an area of 32,060 square miles. In western Asia there lies what is really a larger lake, the salty Caspian Sea. Its area is approximately 169,000 square miles.
- In the tundra lands of the Arctic, the summer heat is sufficient to thaw only the surface of the ground.
- In the mullet fisheries off the west coast of Mexico, the fishermen place nets reaching just to the surface of the water. Beyond a net is an open canoe. The fish jump over the top of the net and land in the canoe, which is what the fishermen intend.
- This delectable food is made in especial quality and quantity in the city of Matanzas on the north coast of Cuba. The guava fruit is so soft and fragile that it is seldom shipped to northern countries.
- Balsa wood, a product of tropical regions in South and Central America. The word "balsa" really means "raft." The tree received this name because its wood was used by the natives to make rafts. It is as light as cork.
- Parts of The Netherlands. Although the fields and towns lie some feet below the level of the sea, the strong dikes keep out the water.
- This is probably the largest of trees, although not the tallest. The trunk of a baobab has been known to reach thirty feet in diameter. It is a native of the tropical parts of Africa, but flourishes especially in the Congo and in the British territories east of the Congo.
- Rome claims to be nearly 2,700 years old, having been founded, so the legend states, in 753 B.C. It is probable, however, that the city that has been continuously inhabited for the longest time is Samarkand, east of Kashgar, in what is now Turkestan. There is reason to believe this city was a trading post for Babylonian merchants more than 3,000 years ago.
- On the southern rim of the Tarim Desert there exist, some 2,000 years ago, a number of commercial towns and cities. The mountain streams that supplied these cities with water have dried up. The cities were abandoned and eventually covered with drifting sand from the desert. Some of these ruins have been excavated in recent years.
- Undoubtedly that on the island of Krakatoa, a small island located in Sunda Strait, between the islands of Sumatra and Java. On the morning of August 27, 1883, the entire top of the island of Krakatoa blew off. More than 40,000 people are believed to have been killed.
- Among the places where records have been kept for many years by the United States Weather Bureau, the driest is the city of Phoenix, Ariz., the average rainfall being less than eight inches a year. However, it is certain some places in the desert part of eastern California are drier.

# Weak batteries? Never with Rectigon The Two-Rate Charger

CONNECT your battery permanently to Rectigon — it will automatically "trickle in" new power to replace what you use; or, if unusually long periods of set operation drain the battery faster than a "trickle" will recharge, just swing the leads over to Rectigon's high rate terminals and bring the battery to full charge quickly and without bother.

You need only the one charger to

3Ampere Rectigon  
~~\$18.00~~  
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5Ampere Rectigon  
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keep your "A" at top notch for every program. Rectigon will recharge your wet "B" just as easily.

Rectigon is made by Westinghouse — broadcasters of the first radio program from KDKA, back in 1920. Rectigon is safe, compact and simple. No moving parts to break or wear out, nothing to damage the set even if you tune in while charging. Get Rectigon at your dealer's.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., E. PITTSBURGH, PA.  
Offices in All Principal Cities • Representatives Everywhere  
Tune in with KDKA—KYW—WBZ—WBZA

## Westinghouse Rectigon Battery Charger

Rectox — for trickle charging only. Just attach the leads to your battery and connect Rectox to the light line. Left permanently on charge, at either  $\frac{1}{2}$  or  $\frac{1}{4}$ -ampere charging rate, it keeps your "A" battery power peppy. No messy liquids, no moving parts, nothing to wear out. At your dealer's.



Besides Rectigon and Rectox for better battery charging, Westinghouse also makes Micarta panels and tubing for better insulation, and radio testing instruments for better reception.



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From the "Big, Friendly  
Radio House"  
NEW 1928 Book offers finest,  
newest well-known sets; parts,  
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MANUSCRIPTS Typewritten, Rates Reasonable. Write: Miss L. L. Trissler, 1642 Twentieth Avenue, Altoona, Pa.

AUTHOR'S Manuscripts properly typed and arranged are half sold. Proffitt, B1071, Knoxville, Tenn.

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DELIVERY bodies for Ford Model T. Chassis with inclosed cab, suitable for Contractors, Grocerymen and Farmers. Three styles. Price \$49.50. Write Daniel Zimmerman, Craigville, Indiana.

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THE American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 6741, 3601 Michigan Ave., Chicago, Illinois.

BIGGEST, Best Catalog Model Airplanes, Parts, Supplies; 5c postpaid. Ideal Company, 163½ Spring Street, New York.

SEND dime for 12 inch mounted propeller and circulators on free three foot model aeroplane. No selling. Aero Shop, 3050 Hurlbut Ave., Detroit, Mich.

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THE Famous Hossfeld "Wrenchless" Universal Iron Bender is the last word in bending machines. Bends metal cold or hot into most any conceivable shape, including Eye Bolts and Automobile Spring Eyes. Bends up to 1" bars or 1½" pipe cold. Thousands in use by all classes of trade, from the smallest shops to the largest railway systems. Write for circular and prices. Hossfeld Mfg. Co., Winona, Minn.

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RATES 30 CENTS a WORD. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the January, 1928, issue should be received by November 5th.

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says the

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Read what the Central Scientific College of Fargo, No. Dak., says—

Classified Manager  
Popular Science Monthly  
New York, N. Y.

Dear Sir:

It is a very small advertisement to be sure, but the returns have been far superior to any other magazine that we use. It puts us in contact with a high grade of worthy students, who desire to continue with their studies.

As we seek only a high grade of older students, we do not know of any other magazine that will do better work than the POPULAR SCIENCE MONTHLY. It is "top of the list" with us.

Very truly yours,

CENTRAL SCIENTIFIC COLLEGE

It is paying 250 classified advertisers to use POPULAR SCIENCE MONTHLY—it will pay you. Let us send you further proofs of the pulling power of this section and closing dates. Address your inquiry to—

### Manager Classified Department

### POPULAR SCIENCE

### MONTHLY

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PAINTERS, Decorators, Artists—Books 10c up. Circulars free. King, Box 1482, Indianapolis, Ind.

PRESS and public concede it to be the best ever produced. "Radio Theory and Operating," by Mary Texanna Loomis, member Institute of Radio Engineers, lecturer on radio, Loomis Radio College. Thorough text and reference book, 888 pages, 700 illustrations, price \$3.50, postage paid. Used by Radio Schools, Technical Colleges, Universities, Dept. of Commerce, Gov't Schools and Engineers. At bookdealers, or sent on receipt check or money order. Loomis Publishing Company, Dept. E, 405 9th St., Washington, D. C.

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MAIL forwarded daily. \$3 month; \$7 quarter, 501 Wood Bldg., Glenside, Pa.

WASHINGTON, D. C. Address \$2.00. Forwarded Daily. Hensinger, 413 Insurance Bldg.

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LEARN the collection business. Good income; quick results. Interesting booklet, "Skillful Collecting," free. National Collector's Association, Science Building, Newark, Ohio.

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MINIATURE die-casting machines, \$50.00. Byrd—318 Reed, Erie, Pa.

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WE START you in business, furnishing everything. Men and women, opportunity to earn \$35 to \$100 weekly operating Ragsdale's original "New System Specialty Candy Factories" anywhere; wholesale or retail. Big commercial candy book free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

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PRINT 250 signs or pictures an hour without press, type or machinery. Sample and particulars 10c. Sartco, 1014, Springfield, Ohio.

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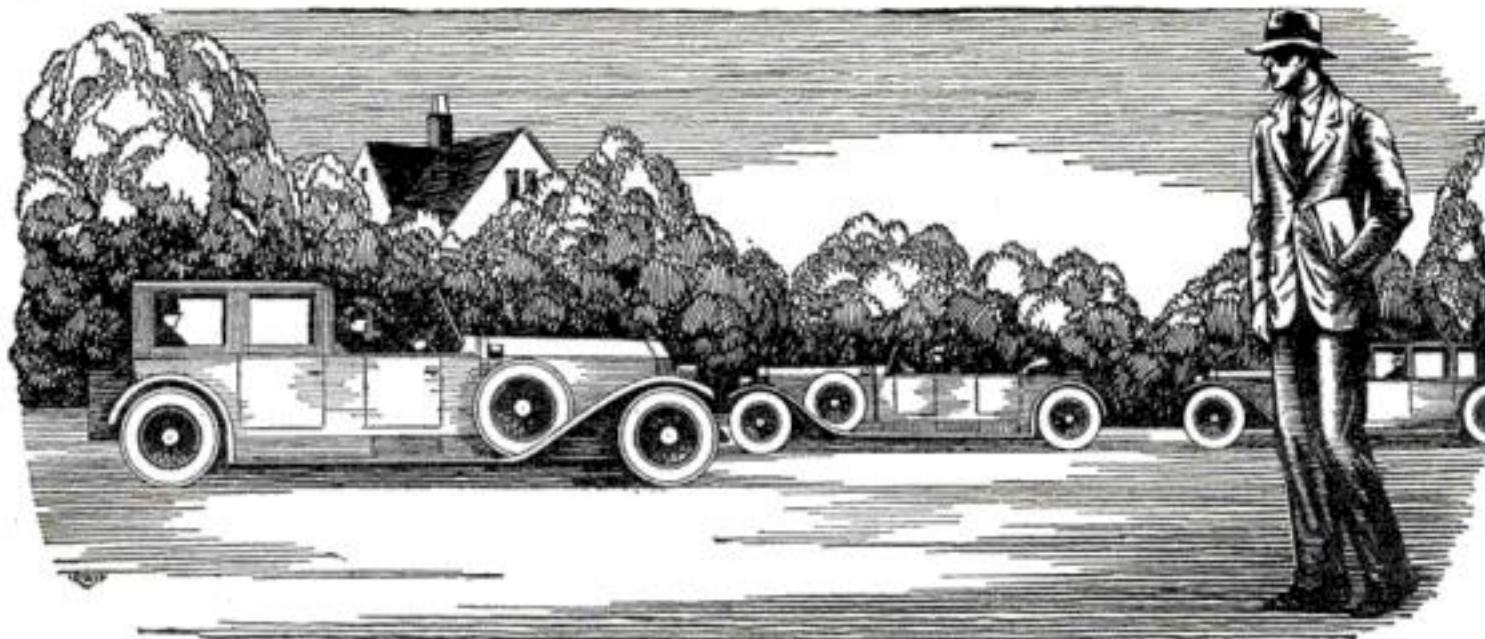
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NEW System Mail Order: big profits, instructions free. Evans S. King Co., Wilmington, Del.



*Many times in the old days while I trudged home after work to save earfare, I used to gaze enviously at the shining cars gliding by me, the prosperous men and women within. Little did I think that inside of a year, I too, would have my own car, a decent bank account, the good things of life that make it worth living.*

# I Thought Success Was For Others

*Believe It Or Not, Just Twelve Months Ago  
I Was Next Thing To "Down-and-Out"*

**T**ODAY I'm sole owner of the fastest-growing Radio store in town. And I'm on good terms with my banker, too—not like the old days only a year ago, when often I didn't have one dollar to knock against another in my pocket. My wife and I live in the snuggest little home you ever saw, right in one of the best neighborhoods. And to think that a year ago I used to dodge the landlady when she came to collect the rent for the little bedroom I called "home!"

It all seems like a dream now, as I look back over the past twelve short months, and think how discouraged I was then, at the "end of a blind alley." I thought I never had had a good chance in my life, and I thought I never would have one. But it was waking up that I needed, and here's the story of how I got it.

**I** WAS a clerk working at the usual miserable salary such jobs pay. Somehow I'd never found any way to get into a line where I could make good money.

Other fellows seemed to find opportunities. But—much as I wanted the good things that go with success and a decent income—all the really well-paid vacancies I ever heard of seemed to be out of my line, to call for some kind of knowledge I didn't have.

And I wanted to get married. A fine situation, wasn't it? Mary would have agreed to try it—but it wouldn't have been fair to her.

Mary had told me, "You can't get ahead where you are. Why don't you get into another line of work, somewhere that you can advance?"

"That's fine, Mary," I replied, "but what line? I've always got my eyes open for a better job, but I never seem to hear of a really good job that I can handle." Mary didn't seem to be satisfied with the answer but I didn't know what else to tell her.

*It was on the way home that night that I stopped off in the neighborhood drug store, where I overheard a scrap of conversation about myself, a few burning words that were the cause of the turning point in my life!*

With a hot flush of shame I turned and left the store, and walked rapidly home. So that was what my neighbors—the people who knew me best—really thought of me!

"Bargain counter sheik—look how that suit fits," one fellow had said in a low voice. "Bet he hasn't got a dollar in those pockets." "Oh, it's just 'Useless' Anderson," said another. "He's got a wish-bone where his back-bone ought to be."

As I thought over the words in deep humiliation, a sudden thought made me catch my breath. Why had Mary been so dissatisfied with my answer that "I hadn't had a chance?" *Did Mary secretly think that too?* And after all, wasn't it *true* that I had a "wish-bone" where my backbone ought to be? Wasn't that why I never had a "chance" to get ahead? It was true, only too true—and it had taken this cruel blow to my self-esteem to make me see it.

With a new determination I thumbed the pages of a magazine on the table, searching for an advertisement that I'd seen many times but passed up without thinking, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. I read the book carefully, and when I finished it I made my decision.

**W**HAT'S happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, *I've had a Radio business of my own!* At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day

I sent for their eye-opening book, I'd been wailing "I never had a chance!"

**N**OW I'm making real money. I drive a good looking car of my own. Mary and I don't own the house in full yet, but I've made a substantial down payment, and I'm not straining myself any to meet the installments.

Here's a real tip. You may not be as bad off as I was. But, think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years, making the same money? If not, you'd better be *doing* something about it instead of drifting.

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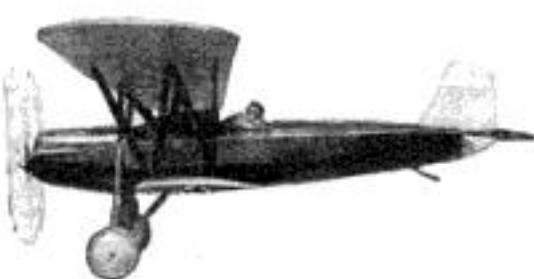
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**PECAN**—Orange—Fig Groves "On the Gulf." Monthly payments. Guaranteed care. Big, quick returns. Suburban Orchards, Dept. "S," Biloxi, Miss.

**OZARKS**—10 acres near White River and proposed power dam, \$100, \$5 monthly. Alva Zimmerman, 1802 N. 5th, Kansas City, Kans.

**LAND** Free if planted to bananas. Bananas bear a full crop the second year. \$5.00 monthly will plant five acres, which should pay \$1,500 profit annually. Reliable Companies will cultivate and market your bananas for you. Bananas ripen every day and you get your check every 90 days. For particulars address Jantha Plantation Co., Empire Building, Block 963, Pittsburgh, Pa.

**Salesmen and Agents Wanted**

**AGENTS**—Clever invention! Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Bldg., New York.

GET our free sample case, toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F, St. Louis, Missouri.

**AGENTS**, \$60—\$200 a week. Genuine gold letters for store windows easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434-A, N. Clark, Chicago.

\$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. F, Decatur, Illinois.

**AGENTS**—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

**Salesmen and Agents Wanted**

**BIG** money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50; make \$1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

**A BUSINESS** of your own—Making Sparkling Glass Name and Number Plates, Checkerboards, Signs. Big Book and Sample free. E. Palmer, 513, Wooster, Ohio.

**AGENTS**—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, N. Y.

EARN \$10 daily silvering mirrors, plating and refinishing metal ware, headlamps, chandeliers, bedsteads. Outfits furnished. F. Deele Laboratories, 225 Varick Street, New York.

**AGENTS**: Make \$500.00 Monthly. Pay daily. No investment. Rhinestone initial buckles and novelties. Sell easy everywhere. Exclusive territory. Chaton Novelty Co., 606 Blue Island, Chicago.

DON'T sell for others. Employ agents yourself. Make your own products. Toilet articles, household specialties, etc. 500% profit. We furnish everything and show you how. Valuable booklet free. Write at once. National Scientific Laboratories, 1901W Broad, Richmond, Va.

\$50.00 WEEKLY easy. Applying Gold Initials on Automobiles. No experience needed. \$1.45 profit every \$1.50 job. Free samples. Ralco Monograma, 1041 Washington, Boston, Mass.

**CALIFORNIA** perfumed beads selling like hot cakes. Agents coining money. Big profits. Catalog free. Mission Factory, H2328 W. Pico, Los Angeles, Calif.

**IMPORTANT** to advertisers! Are you deriving profit from your advertising? Write today for a copy of the "Quick-Action Advertising Rate Folder" showing "How You Can Use Popular Science Monthly Profitably." Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

**MISTER** Agent let me tell you how to make the World's Biggest-selling Specialties as, Sealatite, puncture-proofing liquid for tires; Solvit Hand Cleaner; Mendit, Fabric Patching Liquid; Cellu-iac Automobile Finish—all colors; Bugacide, Fly-killing Spray; Non-Thermic Ice Saving Cloth; Tufnit, for quadrupeds; Silk Hosiery; Duocopol Guaranteed Most Efficient Automobile Polish. Fifty other equally Big Money-Makers. Investment Small. Profits Great! Let me tell you how to get the profit you're entitled to. Miller, Industrial Chemist, Miller Chemical Building, Tampa, Florida.

**AT LAST!** Reasonable priced Auto Emblems for every Lodge. Sells for only \$1.25. Write for attractive selling proposition and FREE sample case offer. North Central Distributors, Department 10, Ashland, Ohio.

**JUST** Out—New Patented Apron. No strings or straps—\$20.00 a day every day; over 100% profit; commissions daily. Write for free offer. Sta-Put Co., Dept. 911, St. Louis, Mo.

**FROM** the Argentine, South America. Latest Novelty, marvelous sales possibility, most unusual, write for full particulars. Write Don Francis X. Cassera, Dept. 117, 23 Washington St., New York City.

**RADIO** Agents—Make Big Money—Easy! selling Marvelous New Sets and accessories. Buy from factory at lowest prices. Get New Catalog with thousands of nationally advertised bargains. Free Call Book. Write today. American Auto and Radio Co., Dept. 288, American Radio Bldg., Kansas City, Mo.

**BIG** bunch mail, Year 15c. Magazines, catalogues, Kentucky Agency, Covington, Kentucky.

**BIG** pay every day! Complete guaranteed line direct to wearer—Dress Shirts, Work Shirts, Flannels, Overalls, Pants, Leather Coats, Sweaters, Playsuits, \$10-\$25 daily! Experience unnecessary. Big Outfit Free! Nimrod Co., Dept. 25, 4922-28 Lincoln Ave., Chicago.

**GOLD** leaf window letters and script signs. No experience; 500% profit. Samples free. Consolidated, 69-Y-West Van Buren, Chicago.

**WONDERFUL** new moisture gas saver. All ears, 400% profits. Doubles Mileage. 1 free. Critchlow, A-120, Wheaton, Ill.

**MAKE** \$1000 before Christmas selling exclusive personal Christmas cards in distinctive steel engraved designs. Expensive sample book free. Wetmore, Janes and Sugden, Rochester, N. Y.

**LAMB'S** Wool polishing mittens, brushes. Newhall, 358 Broad, Lynn, Mass.

**BIG** winner for Agents. New patented cigarette case. Holds package cigarettes and box safety matches; beautiful, compact, flexible container; large profits; write for liberal proposition. All-In-One, Dept. S-11, 2810 Portland Ave., Minneapolis, Minn.

**MAKE** \$25.00 daily selling colored Raincoats and Slickers, Red, Blue, Green, Etc., \$2.95. Hat Free. Commissions daily. Outfit FREE. Elliott Bradley, 241 Van Buren, Dept. AC-11, Chicago.

**100% PROFIT** on every sale selling Christmas Greeting Cards in Box Assortments. Our wonderful Box Assortment is the finest published. Agents earn \$2 to \$4 per hour. We have a magnificent Box Assortment containing 21 high-grade Christmas Greeting Cards and Folders, each with envelope. Steel Engraved, Colored, Panelled, and Bordered. Sells for \$1.00; costs 50 cents. Nothing ever sold begins to compare with the sale of Christmas Box Assortments. Write immediately for particulars and free samples. Waltham Art Publishers, 7 Water St., Dept. B-27, Boston, Mass.

**BANKRUPT** and Rummage sales. \$50.00 daily. We start you, furnishing everything. Distributors, Dept. 34, 429 W. Superior, Chicago.

**POLMET**—The Wonderful Polishing Cloth that cleans all metals without liquid, paste or powder. Approved by "Good Housekeeping" and "Modern Priscilla"—sells fast at 25c. Sample free. F. C. Gale, 15 Edinboro St., Boston.

\$75.00 WEEKLY to Introduce "Chieftain" 3 for \$4.95 Guaranteed Tailored Shirts. Full working outfit Free. Your own shirts Free. Cincinnati Shirt Company, Lane 16011, Cincinnati, Ohio.

**SALESMAN** selling to men. We have side-line for you that will sell along with any other line you may now be handling and make more money for you, provided you are now selling to men. Get full facts at once by addressing Salesmanager, 850 West Adams, Dept. 236, Chicago.

**SUCCEED** With Your Own Products. Make them yourself. Formulas, Processes, Trade-Secrets. All lines. Catalog, circulars free. C. Thasly Co., Washington, D. C.

*Salesmen and Agents Wanted*

AGENTS—Big Seller—\$20 Daily Easy selling Taylor Caps—made-to-measure—every man buys—some want 2 or 3 caps. Samples Free and Cap free to agents. Write quick for fast money making proposition. Taylor Cap Manufacturers, Dept. B-55, Cincinnati, Ohio.

IMPORTANT to advertisers! Are you deriving profit from your advertising? Write today for a copy of the "Quick-Action Advertising Rate Folder" showing "How You Can Use Popular Science Monthly Profitably." Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

SELL Wonderful Hand Adding Machine. \$1. Wholesale. Retail, \$4.50. Typewriter Supply, 104 Hersch Bldg., Pittsburgh.

AGENTS make \$100 week placing Cigar Lighters with glass advertising front. Free Plan, Drake Mfg. Co., Dept. P., Milwaukee, Wis.

AGENTS—Biggest hit of season—FitsU adjustable Caps and Mufflers to match. \$1.70 commissions in advance on every combination order. \$10 to \$20 a day easy. Write quick for free outfit and free cap offer. FitsU Cap Co., Dept. CM-80, Cincinnati, Ohio.

AGENTS—Sell New Confectionery Specialties to stores—big profits—constant weekly repeat orders—exclusive sales right. Box 971, Richmond, Virginia.

TAKE orders for coffee, flour, dried fruits, canned goods, meat, staple groceries, toilet articles, paints, tires, auto and tractor oils. No capital or bond required. We deliver and collect. Permanent business. Big pay. Write at once. Hitecoo-Hill Co., Dept. 81, Chicago.

WE want Direct to Consumer salesmen or agents in every community for our Magnetic Trouble Lamp—Brite-Lite—the fastest selling auto necessity in the world—retails \$3. BRITE-LITE sells itself on sight—agents make big money. National sales force now being organized. Here is a chance to join a live organization and have exclusive territory. Send details of your past experience and a BRITE-LITE will be mailed with full information. Address National Electric Corporation, P. O. Box 90, Dept. D., Newark, N. J.

SALESMEN to Sell Standardized Printed Forms to business houses. Good commission Hilliard—2663 Main St., Buffalo, N. Y.

EASY Money wearing free shirts. Be my local distributor. Greatest values ever offered. Big profits. Fashionwear Shirt Co., Dept. P-363, 1220 Jackson St., Cincinnati, Ohio.

WHY not sell us your spare time? \$2.00 an hour. \$19.70 Daily Easy Full Time. Introduce 12 months. Guaranteed Hosiery—47 styles, 39 colors for Men, Women, Children, including latest "Silk to the Top" Ladies' Hose. No capital or experience needed. We furnish samples. Silk hose for your own use free. New Plan. Maccochee Hosiery Company, Road 15211, Cincinnati, Ohio.

AGENTS, Demonstrators, Streetmen, Mail Order Men. After much effort we have secured the so called Self Shaving Cream formula. No soap or brush needed. Just rub on and wash off, and you have a clean shave. Think of the world wide sale of it. Every man a user. Women use it to remove superfluous Hair. Anyone can make it at home. No machinery needed. Be the first in your locality to supply the cream or sell the formula. Send only \$1 bill for five other secret formulas, and get the Self-Shaving Cream Formula Free. Pikers keep away. No free particulars. The ad tells all. Mail a dollar bill and get the works. Modern Company, Dept. B, 540 E. 35th St., Chicago.

ANTIFREEZE prevents radiators freezing. Drieleen the combined auto cleaner, polisher. Radiator internal cleaner. Hand soap. Write for free shipment long profit auto specialties. Mickman Co., St. Paul, Minn.

SALESMEN—Powerful Moneymaker. Electric advertising cigar lighter, flashing multicolor art movie ads. Sells easily. Make \$255 weekly. Federal Mfg. Co., St. Paul, Minn.

AGENTS every Car Owner and Housewife will buy Auto Mitten Dusters. Sample Offer and Particulars FREE. National Fibre Broom Co., St. Louis, Mo.

AMAZING New Glass Cleaner offers you \$15 a day sure! Cleans windows, windshields, show cases, etc., without water, soap or chamois. No muss. Easily demonstrated. Housewives, motorists, garages, stores, institutions buy on sight. Write for Special Introductory Offer. Jiffy Glass Cleaner Co., 9399 Monmouth, Cincinnati, Ohio.

SALESMEN—\$3 to \$6 an hour introducing amazing new Waterless Cooker. Endorsed by food authorities. Every home a prospect. Going big. Sure-fire sales plan. Men, women, district managers, write for real money-making offer. Health Cooker Co., Dept. M-51, Massillon, Ohio.

NEW! Amazing "twin" invention! Automatic machine for opening cans; "Magic Groove" sharpener for knives, scissors, tools. Needed everywhere. Big profits. Complete outfit furnished. Write quick for introductory Test Offer. Central States Mfg. Co., Dept. P-1041, 4500 Mary Ave., St. Louis, Mo.

WE PAY \$48 a week, furnish auto and expenses to introduce our Soap and Washing Powder. Buss-Beach Company, Dept. A-48, Chippewa Falls, Wis.

AMAZING new scientific invention making agents \$15-\$20 daily; kitchen necessity; dollar seller with big profit; sell two or more every call. Cooking Disc Co., W163 E. Superior, Chicago.

BIG MONEY easily made without peddling or outfit. Free particulars. Elite, 38D Elizabeth St., N. Y.

AGENTS—We start you in business and help you succeed. No capital or experience needed. Spare or full time. You can earn \$50-\$100 weekly. Write Madison Company, 566 Broadway, New York.

AMAZING new invention. Abolishes rubber stamp! Sells every office. Big commissions. Write immediately. Manager, 59 Russ St., San Francisco, Calif.

FREE pants and free mufflers with \$15.00 suit or overcoats. Agents make \$3.00: Beautiful patterns and colors. Fastest sales proposition. Large samples free. Universal Tailoring Co., 640 Broadway, Dept. 19, New York.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly 250 Fourth Avenue, New York.

*Situations Wanted*

PACIFIC Coast Representative for Eastern Manufacturers. Experienced. References. Box 71, Seattle, Wash.

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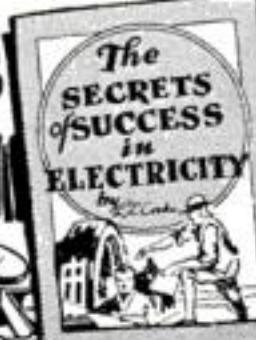
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*The "Cooke" Trained Man is the "Big Pay" Man*



## An Oil Subway of 90,000 Miles

(Continued from page 35)

loaded into larger barges and shipped to Pittsburgh, 133 miles away.

All was well when the river was high, but during the dry season there was not enough water to carry the boats, and a "pond freshet" was resorted to. Twice a week, the eight hundred or so barges were collected along the route and a sort of mill pond made by damming the stream. When the dam was cut, the barges with their cursing and cheering pilots rode down to market on the flood waters. Mules hauled them back, unloaded. Jams, accidents, and fights marked this crude system.

**I**N THE high tide of the movement, 1,000 boats, thirty steamers, and 4,000 men plied this lively trade. Soon the boatmen's wage demands became exorbitant, and a thousand teams of horses and mules were imported for the traffic. Though they could not compete with water rates, they remained to haul oil from the wells to the boats. As many as six thousand teams were employed in Pennsylvania in the early sixties—endless trains of wagons loaded with barrels of oil. The teamsters were a reckless lot; during the week they cursed their horses and repaired bottomless roads with anything that came to hand, and Saturday, when they were paid off, was marked by drinking orgies and brawls that took every nickel of their high wages.

In 1861 Herman Jones, of Erie, Pa., conceived the idea of transporting crude oil through a pipe from Tarr Farm to Oil City, seven miles away. The project, however, fell through. A bill introduced in the Pennsylvania legislature a year later to lay a wooden pipe line from Oil City to Kittanning was defeated by four thousand teamsters who saw their occupations threatened.

In the same year, they tore up a pipe that J. L. Hutchins had just laid from Tarr Farm to Oil City, which delivered oil at the Humboldt refinery by means of a rotary pump Hutchins had devised. The inventor laid another pipe, also torn up. He appealed to the oil producers for protection, but they were afraid to aid him, so powerful was the teamsters' domination.

In September, 1865, Henry Hartley started to lay the first successful pipe line in the history of the world, so far as is known, from Benninghof Run across five miles of country to Shaffer, terminus of the Oil Creek Railroad. Teamsters cut pipes, burned camps and even threatened the lives of the workers. But they had picked the wrong man.

**H**ARTLEY brought armed guards who drove off the disturbers and allowed the repair of the lines to go on in safety. He issued a proclamation to the teamsters promising death if they again interfered. The line was completed and delivered as many as 800 barrels a day.

Soon other lines sprang up as oil was discovered in Ohio, Indiana, Oklahoma, Texas, Wyoming and other points. Until they were officially privileged as common carriers in 1906, the oil lines were not permitted to cross a railroad right-of-way. Railway men considered them deadly rivals, and small wars would be waged when by night the oil men would attempt to tunnel beneath the railroad tracks. Now the oil lines follow the railroad lines wherever possible.

Today eight hundred million barrels of oil pass through the pipes yearly. More than eight hundred million dollars are invested in them. Old feuds have been forgotten. The hardy race of men known as "pipeliners" now combat Nature alone to place their priceless tubes across the wilderness.



## THEN CHOOSE AVIATION!

ARE you a red-blooded, daring he-man? Are you eager for a life of constant thrills, constant excitement and fascinating events? Do you crave adventure, popularity, admiration, and the applause of great crowds? Then why not get into the Aviation Industry—the greatest adventure since time began—the greatest thrill ever offered to man?

Think what Aviation offers you. Thrills such as you never had before! The praise and plaudits of the multitude. And a chance to get in on the ground floor where rewards will be unlimited!

Aviation is growing so swiftly that one can hardly keep track of all the astonishing new developments. Air-mail routes have just been extended to form a vast aerial network over the entire U.S. Airlines and airplane factories are springing up all over the country. Men like Henry Ford are investing millions in the future of commercial Aeronautics in America! The possibilities are so tremendous that they stagger imagination.

Everything is set for the greatest boom in history. The fortunes that came out of the automobile industry and out of motion pictures will be nothing compared to the fortunes that will come out of Aviation! There is just one thing holding it up:—lack of trained men! Even in the beginning thousands will be needed—and generously paid. The opportunities open to them cannot be over-estimated. Those who qualify quickly will find themselves on the

road to undreamed of money—success—popularity—and prominence!

### Easy to Become An Aviation Expert

Get into this thrilling profession at once while the field is new and uncrowded. Now—by a unique new plan—you can quickly secure the basic training for one of these wonderful high-salaried jobs, at home, in spare time. Experts will teach you the secrets—give you all the inside facts that are essential to your success. And, the study of

Aviation is almost as fascinating as the actual work itself. Every Lesson is chock-full of interest—and so absorbing that you actually forget you are studying. But best of all are the ultimate rewards you are fitting yourself to gain!

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Send the coupon for our new, free book, just out—*Opportunities in the Airplane Industry*. It is vitally interesting, reads like a romance and tells you things about this astonishing profession you never even dreamed of. This book is so fascinating it could easily sell for a dollar. We offer a limited number FREE. Write for yours today.



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Please send me FREE your 48-page booklet. It is understood that this request puts me under no obligation.

Name.....

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## Laboratory May Produce Life

(Continued from page 23)

mind, and mind as the conscious apex of life. They are, so to speak, the same thing in different stages of development. Neither is a mere consequence of complex material substance.

Our bodily mechanism consists not only of muscles, through which we alone act on the external world, but it contains a brain and nervous system which controls and works these muscles and receives impressions from our sense organs. Yet the brain is merely the chief instrument which mind, or life, utilizes, and through which all the rest is accomplished. If the brain is damaged, or out of order, the manifestation of life is imperfect, or may cease altogether. This familiar fact has led some people to say that mind has no existence apart from the brain, that brain is not so much the instrument of mind as it is the mind itself, and that when the brain is destroyed, the mind is destroyed too.

THIS does not follow at all. In fact it is contrary to all analogy. A close examination of the brain will not explain thought, though it will show us the mechanism by which thought is reproduced in material form that we can perceive. Examination of the instruments of an orchestra, or the strings of a piano, would never yield a symphony or a sonata; and yet these instruments are necessary for its reproduction or manifestation. A savage wandering in the interior of an organ would be no nearer the understanding of music; nor would he be destroying music if he wielded a hatchet in his journey; though he would be injuring its presentation. Similarly, even if we could see the processes going on in the molecules of the brain, the rhythm would be interesting, but we might not be any more enlightened than if we merely witnessed the movements of conductor and violinists in an orchestra.

How then shall we discover the secret processes of this all-controlling mind, or life, or vitality, which, though apparently distinct from material substance, interacts closely with matter, thereby manifesting itself and achieving its purposes?

IT IS plain to everyone that matter does not exhaust even the physical universe. The ether, or whatever is equivalent to it, must be taken into account; though this and all ultra-material things—such as beauty, intelligence, aspiration, faith, hope, love—are only known to us in their association with matter. We have discovered, for example, that light is an ethereal vibration, but what we see is not the light itself, but the material objects on which it falls.

If the ether is constituted as I believe it is, it must be the seat of enormous energy, not necessarily infinite but far beyond any energy of which we have any conception. All the energies that we experience in matter are but a minute and residual fraction of the ethereal energy of which they are a feeble manifestation.

My speculation is that this boundless ether, thus full of energy, is utilized and is impregnated throughout with something that may be called life and mind in the highest degree; that it is the home of the ideal and the supernal, and that all life and mind we are conscious of is but a tiny fraction of this majestic reality. I conceive of the ether as the vehicle or physical instrument of this supreme mind. It may be that "spirit" is a better term, that spirit permeates and infuses everything, and that it controls, sustains, and has brought into being the visible and tangible frame of things.

In myself the conviction has gradually formed that the physical ether is literally and physically squirming or pulsating with life and mind. It is as if we might regard it as a great reservoir of life, from which separate individual fragments

can from time to time be drawn, as from a store of raw material in a warehouse. Life is not really generated, but is entrapped by matter. And so it may be possible for us, probably some centuries hence, to construct an efficient trap, and thus to offer a material habitation to otherwise purely ethereal life.

MANY persons, I know, will feel afraid of such a conclusion. They will say that such a self-acting mechanism for the creation of life would remove from the universe the need for a planning and creative Mind, so as to be out of harmony with certain deeply implanted instincts and religious ideas. These fears seem to me groundless. For the process we have assumed as some day possible in a laboratory, is surely not a self-acting process at all. A chemist who in the future may discover how to construct protoplasm and to infuse it with vitality, is himself no self-acting machine. He surely is full of knowledge and contrivance and planning, and is conducting operations full of understanding and design. That life, therefore, when it appears, will not have come into being without antecedent life. The chemist or physicist who does it will have been alive, and will only have designed and accomplished it through the agency of a powerful mind. The phenomenon will not have occurred haphazardly or without thought. There is nothing in the process to which exception need be taken. Rather, it might be welcomed, even by religious people, as showing what amount of thought was necessary to produce any imitation of actual existence. If we are wise, we never will be afraid of any progress in knowledge; we will never oppose or obstruct the achievements of science.

At present there are some who will try to say that the ether does not exist, and that the idea of life and mind existing out of association with a material organism is an absurdity. They do not see that the really strange problem is how life and mind came into association with matter at all. They will not entertain the notion that they are incarnations, for a brief period, of a persistent something that is not material. And they deny the possibility of any other mode of existence.

THE fact is that mere survival or continuity of existence, when regarded from the proper point of view, must be admitted as inevitable. The only rational question is about individual survival. And that question must be answered by an investigation and scrutiny of facts which are gradually forcing themselves more and more on our attention, but which are not yet accepted or studied by any of the orthodox sciences. They are, in fact, too simple, too concrete, too like the ordinary experiences of daily life, to be palatable to the majority of scientific observers; and accordingly, though partially apprehended by the simple, such facts are usually ignored by those who consider themselves the wise and prudent.

### Germans Make Gas from Sewage

REMARKABLE success of new German processes for converting sewage and similar wastes into gas for household use were described recently before the Royal Sanitary Institute at Hastings, England. They could as well be employed in producing gas for industrial purposes. At Gross Zieter, Germany, sewage produces enough gas, it was reported, for the domestic supply of a population of 8,000.

Inflammable gas is produced from sewage by two methods. In one, certain kinds of bacteria are allowed to act on the sewage mixed with water. In the other, the sewage is dried and subjected to the same kind of distillation by heat that is used in making gas from coal.

## Bridges Built of Magic Dust

(Continued from page 39)

powdered raw materials, though quite well mixed, must be combined physically and chemically. This is accomplished in the kilns, which may best be described as overgrown blowtorches. Automatically conveyed to the upper end of the slightly tilted kiln, the raw materials start on a two- or three-hour journey through the brick-lined cylinder which is hotter by several hundred degrees than the volcano Kilauea, the only one whose temperature has been measured. A large kiln requires a ton of coal every twelve or fifteen minutes, or the equivalent in gas or oil! The coal consumed amounts to 200 pounds for each 376 pounds of cement manufactured. The most commonly used fuel is coal, fed into the kiln in pulverized form through a pipe under pressure. In some cases the black powder is brought from the coal-grinding equipment a half mile away through a pipe line.

AS THE kiln rotates, making about one revolution every minute and a half, each particle of raw material gradually comes in contact with the flames, which shoot out in a roaring tongue thirty or forty feet long. Slowly the powdered materials form into white-hot balls the size of marbles. Gazing through a small peephole, a workman can tell through long practice whether the chemical changes are taking place properly. Oftentimes he will measure the kiln temperature by a pyrometer or temperature gage. Near the butt end of the kiln the fiery balls drop through an opening. These balls, called clinker, may be considered as potential cement and may be kept in storage for the peak demand for cement in the summer months.

Powerful mills, usually of the same type as those used in preparing the raw materials for burning, pulverize the clinker. A small amount of gypsum, not more than three percent, is added to regulate the time of setting of the cement when used; otherwise it would harden before the workmen could place it in the forms.

The gray powder that comes now from the tube mill is Portland cement—a powder as potent as dynamite, but in a different way. If it were not for this cement, the great Muscle Shoals project would never have been contemplated, neither would Uncle Sam have undertaken construction of the Panama Canal, for cement is the only building material which may be used almost as easily under water as on land, and which will not deteriorate through rotting or rusting.

PORLAND cement must be so fine that more than three fourths of it must pass through a sieve of 40,000 holes per square inch—a sieve so fine that it holds water. This careful test has been made possible through highly efficient wire weavers who spin fine wire threads and weave them into a shiny wire cloth, finer than an excellent quality of silk, which may have five thousand holes less per square inch.

Filling sacks with shovels was a slow back-breaking process. But nowadays automatic machines, each with a single operator, can fill at least 4,000 sacks a day. Last year enough cement was shipped to fill 650,000,000 sacks. But since cloth sacks are returnable, most of them make two trips yearly, so 250,000,000 of them are kept in service. In addition 100,000,000 paper bags were used in 1926. And to carry these sacks and bags from the mills requires 725,000 railroad cars.

A remarkable thing about Portland cement is that, although it is made by a hundred or so different companies in the United States, the material has the same chemical qualities the country over. It is manufactured in accordance with Government specifications and, like sterling silver, must meet certain standards.

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## Contact!

(Continued from page 20)

receiver, made of just a vacuum tube, coil, condenser, rheostat and phone. There was a touch of affection in the way he handled it. How the little outfit recalled the happy days back home when, as a boy, he had saved his nickels to buy those parts; waited day after day for the postman to come with the package; unwrapped the apparatus with trembling, eager fingers; assembled the outfit on the cover of a cigar box!

When he was thrust into a wire company at the training camp instead of being assigned to a radio company as he requested, he made a place for it in his pack, and here it was. It was crude, it had no selectivity, but his little first set never had failed to bring in something. It seemed to have a personality, a soul, as inanimate things have when we have created them, lived with them, loved them. No regulation pack set could have filled him with such confidence.

**H**E SMILED as he thought what would happen to him if, back home, he should do what he was doing now, connect a spark coil right in the aerial circuit. How it would mess up the ether and interfere with Government and commercial traffic on all wave lengths! But a broad wave was what he wanted now, one that required no critical adjustments at either end. And the simple little receiver was just what was needed, now that there was but one station to bring in and the crashing of the shells made it hard to hear anything. A wire thrown over the limb of a tree served as his receiving aerial.

He connected his outfit with the battery.

“Ready sir!” he said. “Zero, I learned before the wire was cut, is 4:15.”

The commander barked orders to those around him. Burden used the brief moment to send a test call to Beezo. A tense moment of listening, and Beezo replied. Knowing what Burden had to work with he had figured out roughly how he should tune to the improvised outfit for best results. The problem of spanning the short radio distance between them was not difficult for buddies who had been “hams” together. Beezo radioed that the general said he must be placed in communication with the 55th at once.

The commander gave Burden his messages, sentence by sentence. Everything indicated that the Germans would attempt to retake the hill at daybreak. They could lay down a barrage that would prevent the 55th from consolidating with the rest of the line, then sweep the hill. He described the situation and awaited orders.

**B**URDEN hammered out the message, adjusted his receiver, and began to copy in a note book. There was a gray streak on the eastern horizon and it was only a matter of minutes before the show would start. He was obliged to use a flashlight, but guarded it carefully.

The shelling ceased and the hum of an airplane approaching from the German line reached his ears. A few moments later, he glanced over his shoulder and in the strengthening light saw a slim object slip from the bottom of a bomber.

The plane was high and flying fast; the object was dropped some distance back and did not appear at first to be coming his way, but in a moment there was no mistaking the fact that it was.

“Jump, sir!” he shouted to the commander, and dove over his apparatus into a shell hole.

An instant later the earth seemed rent asunder. Tons of soil, hurled into the air, came down and almost buried him.

He extricated himself, scrambled to the rim of the hole and looked for his radio outfit. Where it had been (Continued on page 157)

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—will start you on the road to success. See Money Making Opportunities on pages 146 to 174.

## Contact!

(Continued from page 156)

there was a crater ten times as large as the one that had sheltered him when the earthquake came.

His note book still was in his hand. Hearing a voice beside him, he turned and recognized the mud bedraggled commander, just crawling out of the dirt.

"Here's your orders, sir!" said Burden. "The gist of them is to sit tight and wait for the line to catch up with you. They didn't dare lay down a barrage until they knew whether you had any outposts beyond the hill or not."

THE thunder of the heavies, deep, reverberating, prolonged, broke from the Allied front. Far overhead passed hurricanes of death that dropped on the German front beyond the hill. Like rolling flames they swept along and as they passed, nothing but smoking, barren, pock-marked earth remained where trees had spread their sheltering arms and buildings had dotted the landscape.

Burden sat and watched the awesome spectacle for some minutes, then slowly his eyes closed, his body sagged and he fell on his side.

Just as the sun appeared, a khaki flood overran the country as far as eye could reach. It swept up to and past the hill, where it was swelled by the 55th.

A Signal Corps truck, loaded with wire and apparatus, followed not far behind the regiment that flanked the hill on the left. It halted. A lanky youth leaped from the seat and ran up the slope.

Searching the terrain rapidly, he came at last to the prostrate form of Burden.

Burden's hair was matted with blood, his clothing and face caked with mud. His head was turned away from his comrade, who dropped on his knees beside him with quivering lips.

"Poor old Burden!" murmured Beezo.

A moment later he laughed aloud, for out of the wide-open mouth of the fallen signal man came an answer to his greeting. It was a sound as of a crosscut saw striking a knot and rattling in its groove. Burden, his job finished, was asleep and snoring!

## Beehive Civilization Exceeds Man's

(Continued from page 28)

flowers. Working with Prof. F. K. Richtmyer and Dr. J. Arthur Harris, Dr. Lutz took photographs of many flowers to determine what color rays they refract. His pictures proved that in addition to red, yellow, blue and green, many flowers refract ultra-violet rays—some of them, such as yellow daisies, in a marked pattern that makes them particularly striking. Further studies indicated that bees can distinguish between the different colors.

A BOX was constructed with windows at each end into which slides of different colored glass could be fitted. After a honey bee had been imprisoned, a red light, say, would be shown at one end of the box. Immediately the bee would go toward it. Then a light of another color would be shown at the opposite end of the box, to see if the bee would forsake the red window and go to it. And so on. It was found that the bees would immediately go to red, blue, green or ultra-violet rays. The attraction of ultra-violet rays, invisible to human eyes, was strongest of all.

From Lutz's investigations, combined with those of von Frisch, three conclusions have been reached.

First, that bees can see flowers in somewhat the same way a color-

(Continued on page 158)



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## Beehive Civilization Exceeds Man's

(Continued from page 157)

blind man can see them, in varying degrees of intensity, and can distinguish the ultra-violet rays to which the human eyes are not sensitive.

Second, that bees have an almost unbelievably acute sense of smell, far superior to that of human beings.

Third, that bees communicate with each other accurately in different ways; among others by dances, feeler rubbing and sense of smell.

The observation hive has made it possible, also, to learn far more of the ordinary domestic routine of the bee than formerly. For centuries it was supposed that certain bees worked at particular tasks all their lives. Now it has been discovered that bees turn from one task to another at different stages of their existence. And they are almost as individual as human beings, working whenever they choose, hurrying or taking time about things, in accordance with their moods and fancies.

After leaving its cell a newly-hatched bee first washes itself. When hungry it begs food from a passing worker. Then it starts in cleaning brood cells, that have to be brushed out before the queen will lay another egg in them. After two or three days the young bee visits the pollen stores. She eats what she wants, then goes into nurse's training. She carries honey and the food known as "bees' bread" to the older nymphs. After three or four days she takes up the more advanced work of feeding the younger larvae, and keeps it up for a week or so.

Then comes a tour of exploration over the entire hive. Gradually she becomes interested in the older bees coming in with loads of honey or pollen. Finally she is carried along in a current going out and—flies! No first flight in an airplane can be more thrilling. The young bee does not start off to gather honey immediately. She merely flies for fun and experience.

These trial flights prove that bees rely on memory and not merely blind sense of direction. Until she has made her trial flight, a bee cannot find her way back to the hive. If the young nurses are taken from the hive and liberated, they are not able to find their way back. But once a bee has had a chance to fly about and locate home, she can always return unerringly.

No other living creature in the world, the experiments have shown, has a memory equal to that of the bee, at least in matters of location. Yet the bee's brain, relatively, is small—only 1/174th of the insect's entire weight. Even that is larger, proportionately, than the brain of the ant, which is only one two-hundred and ninety-sixth of its weight.

Usually young bees go back to nursing again after the early exploration flights. Then comes sentry duty—flying near the hive, watching the entrance, fighting off intruders.

Last of all comes field work. Some bees choose pollen gathering, and some gather nectar. It is thought that no bee ever gathers both pollen and nectar; they specialize.

While on field work a bee labors almost incessantly, storing up honey or pollen for the hive. The nectar from two or three flowers would be enough to satisfy the hunger of a single bee for a day, but she visits 200 or 300 flowers. From this nectar honey is made by evaporation, after a drop of acid has been added to it from the bee's body. The evaporation is caused by fanning. Twenty thousand bees will bring in a pound of nectar, which is about four times the bulk of honey; so that 80,000 bees work in making a single pound of honey. To get it they travel a total distance of more than 100,000 miles.



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## Geniuses Who Created Planes of Air Heroes

(Continued from page 33)

at San Diego, when in walked a tall, slim young man, who announced briefly that he wanted an airplane to make a nonstop flight from New York to Paris. This young man—Charles Lindbergh, as you've guessed—was a likable chap. "I'll design the plane you want," Hall promised with enthusiasm, "I'll have the design ready in twenty days!"

IT MEANT designing virtually a complete new plane, but the twenty-eight-year-old engineer was equal to the task. To technical knowledge gained at the Pratt Institute in Brooklyn, N.Y., he had added practical experience as an engineer with the Curtiss Aeroplane and Motor Company and later with the Douglas Airplane Company, whose planes had carried Army flyers around the world.

Hall labored over his drawing board. His meals were brought in. Never did he leave his office except to snatch a few hours of sleep. The drawings completed on time, the company president called his factory men together and gave them just sixty days to build the plane! It was completed on schedule. So came the *Spirit of St. Louis*.

Not to every plane designer, however, has success come so early. Bellanca struggled through many years of discouragement and disappointment before he saw his labors rewarded in the history-making flights of the monoplane *Columbia*—in the one-time record duration flight of Chamberlin and Acosta, and later in Chamberlin's great hop across the sea to Germany.

If you had visited Curtiss Field, N.Y., during the days when Chamberlin was tuning up the *Columbia* for its ocean journey, you might have seen a slight, mild-mannered little man about five feet tall, sitting beside a hangar, jotting calculations on a pad. He would have greeted you with great courtesy and an almost child-like smile. If you had talked with him of aviation, or of his newest plane, you would have seen his thin face alight with eagerness.

"A SIMPLE, gentle soul, this Bellanca," you might have thought. Yet a resolute soul and with this amiable simplicity a mind as keen as a blade.

Out of this man's struggles have come not only a marvelous flying machine, but a distinct and important contribution to aviation science. This contribution, embodied in the *Columbia*, is an ingenious method of making each individual part perform some of the work of lifting the plane into the air and keeping it there. To Bellanca goes the distinction of largely solving the problem of minimizing the resistance of parts which ordinarily do not help the plane to fly. He has made struts, tail surfaces and even fuselage do some of the lifting. The struts are really little wings which, while adding to the strength of the machine, increase its flying efficiency.

Born forty-one years ago in Sciace, Italy, Bellanca's introduction to mechanical things was in his father's grist mill, a primitive affair with huge stones driven through wooden gears by donkeys. But with an ambition to be "an expert business man" the youth entered the Royal Institute at Milan. There he became more interested in mathematics than in business. For a hobby he flew kites, and it was while studying their response to air currents that he determined to learn to fly. A little later he heard of the flight of the Wright brothers at Kitty Hawk in 1903. That decided his future. He would fly and he would build airplanes.

From the outset he was handicapped by lack of funds. Even when he obtained enough financial backing to build his first plane, it was not a great success. (Continued on page 160)

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## Geniuses Who Created Planes

(Continued from page 159)

But he was learning. A flight across the English Channel began to be discussed. The idea fascinated Bellanca. He built a tractor-type biplane, but he had no motor to run it and no money to buy one. Meantime Bleriot flew the Channel. Bitterly disappointed, but not defeated, Bellanca vowed then to build airplanes that would far surpass that feat.

Seventeen years ago he came to America, with a "hopechest" which was nothing more than a grip containing his drawings of his now famous "parasol" monoplane. A year later, having built the plane, he rented a hangar at Mineola, N. Y., and began to teach himself to fly. His friends predicted speedy death, but in three months they changed their minds; Bellanca not only flew, but made turns at a height of several hundred feet and landed safely. This first "parasol" plane is still in existence. Clarence Chamberlin flew it in 1921 with the same old engine turning the propeller.

AT THE time Bellanca first took the air, airplane flights were very much of a novelty. He and his "parasol" staged exhibition flights in various parts of the country. Soon his activities won the attention of the British government. In 1916, when the Allies were looking for new planes, he was given a British contract for the design of an observation plane. But the plane had to be equipped with a rotary motor; and, since no motor of this type was available, the contract was never filled.

Disappointed again, Bellanca moved to Hagerstown, Md., where, during two or three years, he devoted himself to study and designing. There he met Chamberlin and began a close friendship which resulted in the longest nonstop flight up to that time.

In 1921 Bellanca decided to try his fortunes in the west. He moved to Omaha, and there, in a garage, built a monoplane which for the first time embodied his idea of winglike struts.

"Who is this Bellanca?" experts began to inquire. And well they might; for in 1922 a plane bearing this name won thirteen first prizes in four air meets, including the International Air Races at St. Louis. Government contracts for four mail planes followed. Bellanca delivered them in 1924. Since then each of these planes has flown 160,000 miles in the service of Uncle Sam.

When, two years ago, the Wright Aeronautical Corporation, builders of the Wright Whirlwind engine, decided to build one or two test planes, Bellanca joined their staff. And at the corporation's plant in Paterson, N. J., was completed the *Columbia*, the Bellanca monoplane which Chamberlin flew to Germany.

BY COINCIDENCE, at this same New Jersey plant labored another inventor, without whose engineering genius the achievements of Lindbergh, Byrd, Chamberlin, Maitland and Hegenberger might never have been realized. He was Charles Lanier Lawrance, creator of the now famous Wright Whirlwind air-cooled engine, the marvelous, unfailing power plant which drove each one of these flyers over thousands of miles of sea.

Back in 1916 when Lawrance, at the age of thirty-four, was first experimenting with radial air-cooled engines, friendly aeronautic experts told him there never could be a future for that type of engine. Water-cooled engines had been the mainstay of aviation. Lawrance, however, stuck to his idea. His first air-cooled motor was a little two-cylinder affair developing twenty-eight horsepower. This was followed by a three-cylinder radial engine of sixty horsepower. Army and Navy engineers watched with interest and by 1919 these engines were driving messenger and training planes in Army and Navy services. Two years later Lawrance

developed a nine-cylinder engine which in a fifty-hour test developed 147 horsepower, in spite of the fact that it weighed only 410 pounds. The same year a 200-horsepower engine was delivered to the Navy.

From that time the success of Lawrance and his engine was assured. The company he had formed was taken over by the Wright Aeronautical Corporation, and Lawrance became president. With improvements added, the engine was introduced as the Wright Whirlwind 225-horsepower. The public, however, did not hear much about it until Commander Byrd and Floyd Bennett flew over the North Pole in a Fokker plane powered with three of the Whirlwinds.

YET this genius of power has set still higher goals. Only the other day he announced the completion of successful tests on a new Whirlwind with fifty more horsepower, consuming ten to fifteen percent less fuel. He and his consulting engineer, Ed Jones, soon will announce an air-cooled engine to be called the "Cyclone," with 525 horsepower!

But given reliable airplanes and unfailing engines, even the most skilful pilots could not hope to fly across the ocean without "bird sense"—without sensitive instruments to guide them safely on their way. It remained for another young man, Charles H. Colvin, to supply this need. All of the noteworthy long-distance American flights have been carried to success through the instruments of navigation invented and manufactured by the company of which Colvin is the guiding genius.

Colvin's first adventure in aviation was in 1910, when he was only seventeen. A real estate development company in East Orange, N. J., had hired a pilot and one of the old type Bleriot monoplanes to attract the public to its property. Colvin, who had been interested in newspaper and magazine work in high school, and who had been eagerly reading accounts of pioneer airplane flights, went to "cover the story." The plane taxied across the field, but refused to go up!

That night Colvin failed to return home. For a week he was lost. Just when his parents were preparing to notify the police, he wandered in with the explanation that he had been watching the pilot try to fly.

For the next three years, while he studied in Stevens Institute of Technology, he spent many a Sunday at the Long Island flying fields. At the end of his junior year he got a job with the Curtiss Aeroplane and Motor Company as a mechanic, working on the assembly of airplane engines. Soon he was transferred to making metal fittings and assembling planes.

THIS work took him into the field. There he made friends with the late Lawrence Sperry, Morris Titterington, inventor of the earth inductor compass; J. D. Hill, who with Lloyd Beraud attempted to fly *Old Glory* to Rome; and with flyers at the Curtiss school. Sperry asked Colvin to work with him on airplane instruments in a department of the Sperry Gyroscope Company. Soon he was given charge of the flight testing of Sperry instruments, particularly the stabilizer, known as the "automatic pilot." In 1916 he was an observer in the first flight ever made in an airplane entirely under automatic control.

After the war, Colvin, Titterington and H. Goldsborough started the Pioneer Instrument Company.

"We nearly starved to death the first few years," said Colvin.

Yet from those years of hard work came the marvelous instruments that have given eyes to flyers where human vision cannot peer beyond blanketing fog or the borderless expanse of sea.

## Whirling Wheels

(Continued from page 44)

for the Madison Square Garden for the next five years. These—unlicensed—men are in the cold. They're out."

Followed by an accepting, convinced look on Mr. George Fosdick's face. Jim had won; Gil had lost. They all knew it. That was the reason for Jim's addition of that nasty insinuation.

"No, Gail; we didn't get the contract," was all Gil said when he had gone to her again. But he had to explain the reason for his black eye, while she crooned over it and told him not to care.

**D**ETROIT, and the blackened skeleton of what had been a wooden hive of production. "The cannon stoves did it," explained Bob Legg. "The weather was cold, and Mac had 'em both red-hot. Then some idiot brought in a can of gasoline to wash off a greasy frame."

The factory was junk; the machines were covered with charred timbers; warped and twisted line shafting writhed up like a frozen snake; the experimental room with its nearly finished floor, the office with all its drawings and records—everything was junk!

"Except two 1903 models," said Gil. "The Chicago one ought to be here right now. Wally's waiting for it." There was a far-away look in his eyes; already he was planning. "Did you get a plant?"

"Two of 'em. Mac said neither one of 'em was big enough."

"Where's Mac?"

"Getting them both lined up."

Then Gil turned to Gail, who was standing close beside him in the frozen slush. "Gail, dear, this isn't going to be much of a honeymoon. We've got some things to do and you won't see much of me."

She pressed her shoulder tightly against him; her blue eyes were bright. "But I'll be right where you can find me any time you want to," she promised.

And out of the ashes of an ex-carriage factory rose the spirit that was to master big Jim Wenden—teamwork, with loyal men rallying behind a lean-faced leader whose eyes never wavered from his job.

At first there were the two plants, with Mac driving one and Wally the other, and each using automobiles for counters in the game of "get out the most." Then both forces were joined in a new steel and concrete building that rose on the vacant land once offered to Jim for a million dollars a foot. A broad, two-story front, with one wing, then two, then three, extending back from it, and men in greater and greater numbers joining the battle for speedy production of speed. With Gil here and there and everywhere, doing the work of a dozen men through all of the days and most of the nights, and his helpers following like keen-nosed dogs on the trail.

**T**HREE was Bob Legg, who said a law practice was too slow. He took over the details of management. Mac stuck tight to the shop, at first to oversee the assembly line that Gil had conceived, then to plot the course of machine work as the wings went up one by one and filled themselves with machine tools. Wally, finished with the game of beating Mac in a temporary shop, swung the greater and greater task of meeting service needs. Andrews and Morton, selling out their New York agency, came to Detroit during that first bitter spring. It was no picnic, that next year, nor any of the years that followed; it was work, work, work, day and night. But it was play as well; for wasn't this The Game, with a certain player to be whipped?

The second floor of the front building was given over to offices. Gil had a spacious room in one corner. The others—all but Mac, who insisted upon a

(Continued on page 162)

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## Whirling Wheels

(Continued from page 161)

glass-walled affair down in the shop—were lined up across the front. The space behind was open, and filled rapidly with desks where clerks worked, telephones rang and typewriters clattered.

They produced fifteen hundred machines that year after the fire. Fifteen hundred runabouts, tonneaus and a mixture of both—a detachable-tonneau that "goes pretty well," as Andrews said. And they did it in three plants, the third one being the new one, into the first wing of which they moved an up-to-date assembly line before the next snows came. And the boss thought nothing of it!

"Well, why should he?" said Wally Burns one day when Andrews remarked about it. "That's old stuff with him. He had that all figured out in the old shop."

Which was true. Gil had been watching the men one day, when they had been driven to death getting out those sixty-odd machines! He had noticed that tote-boxes full of engine parts were being trucked between machines, that when men on the assembly aisle wanted a unit for installation they had to go and get it.

"Now why can't we take the job to the unit instead of the unit to the job?" Gil had asked—and there was the new system all worked out, in the first new wing.

A LONG track of channel irons sunk in the floor, with piles of the various units—axles, transmissions, steering gears, engines and bodies—arranged in the order of their assembly on either side of it. They didn't manufacture a single unit that first year. Everything had been contracted for; the job of getting out machines had been quite large enough. At the front end, beneath the floor occupied by the offices, the whole space was taken up with trestles—the only stationary part of the whole assembly. There the frames, of wood armored with steel, were laid until axles and wheels were attached. Then they were rolled, foot by foot, down the wing that was so long that its sixty feet of width seemed narrow, receiving parts one by one from the gangs of men who stayed in one place and let the jobs roll past them. The shop was filled with broad daylight, for the roof overhead was of saw-tooth construction, its north wall being entirely of glass. Yes, it was all old stuff to Gil.

"He's thinking about five years ahead right this minute," said Bob Legg to a white-haired gentleman who was being shown through the new shop. "And how he does it and carries on the experimental work at the same time is more than I can comprehend."

"YES, he's a pretty bright young man," was Oliver H. Marston's comment. "A pretty bright young man." He had become another believer in Gil Herrick by that time. It was he who had made it possible for Gil to make a new start.

"With mostly my own money," the banker had told his wife one evening. "But he thinks it's all the bank's. If that young man knew how much of it was personal funds—" he chuckled.

It never would have done to express personal confidence in unsecured notes with the funds of the Founders and Merchants National; that was a business institution, and this other—his gray-haired, round-faced wife whose children had left her long before, thought she understood, and smiled softly.

"Perhaps it would be nice to entertain them at dinner some evening," she suggested. "You say he's married now?"

"Yes, and living in furnished rooms," he chuckled. "To be near the plant, he says. But I know. He's no spendthrift, that boy; there's many a man working for him that's making more out

(Continued on page 163)



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## Make More Money

Read the Money Making Opportunities on pages 146 to 174 of this issue.

## Whirling Wheels

(Continued from page 162)

of this than he is—for the moment. He's putting all his money back in the plant. Yes, good idea, mother—if you can find a night when he isn't working all night. Suppose you call on her."

While down in a certain expansive, wood-paneled room with an arched roof and a floor of tile where the players of The Game began to gather, the talk at every round-topped table always reverted sooner or later to one subject. Not the Herrick Automobile Company and what it was doing; no, it was always "G. W.", as Gil came to be called. What he was doing, what he had done.

Who was it that aired that news about the meeting with Fosdick? No one ever knew, for gossip has no sources. Morton thought it was Wally; Wally had told him about it first, but when approached with an expression of that suspicion, Wally denied it hotly.

"What do you think I am?" he demanded. "A tongue-waggin' talkin' machine?" Then he laughed. "Well, maybe I am—to you fellows in the outfit. But do you think I'd be runnin' around town blabbin' that tale? Say, when I jumped in to tear Gil away from that big bum, I got in a couple of pretty good wallops myself! But if any guy thinks I'm talkin' about it—" he glared.

NO, IT could not have been Wally. There was only one other possible source of that news—George Fosdick himself. For the subject of discussion in the Pontchartrain bar always got around to this:

"Yes, sir, he's a comer, G. W. Watch his smoke—and Jim Wenden. Ever hear how he sewed George Fosdick up? Well, it seems the three of 'em were talking about a contract: George, G. W. and Jim Wenden. Something happened, don't know just what, but all of a sudden G. W. jumps up, smashes Jim Wenden on the nose, tells Fosdick where to go, and walks out. And what does Fosdick do? Follows him here to Detroit the next day and makes him take the contract! When G. W. didn't have any more plant than a rabbit!"

That was commonly known, not only by the players but by the more humble workers. And if you want to see a factory go, just let it be known that the Big Boss is a fighter! Especially if, when the dull season comes, as it always did come in the early months of winter in that Game, he lets it be known that he will not close the plant down entirely; he will work half-time instead. For that was what Gil did, as one dull November and December succeeded another. Just try to foment trouble in a place like that! Which, of course, big Jim was fool enough to try.

JIM imported a sleek-tongued, nimble-fingered man from somewhere, gave him his instructions, and sent him over to apply for a job at the Herrick plant. He got one; it was easy to do when he told his qualifications. And then he went to work, at first with his hands until he had made good, then with his tongue.

"Rotten place to work," he growled when there was a little breathing spell. "Never get a minute to sit around."

His fellow workers said nothing.

"Makin' a mint, runnin' us to death, an' sittin' up there with his feet on a desk."

One of the boys looked sharply at him and he changed the subject, only to come back to it later, and time after time, growling, especially at noon, when they were sitting around. Until at last he exhausted the patience of one of them, who looked up from his work.

"Ever work eighteen hours a day?" he asked.

"Naw, why should I? I ain't no slave!"

"Know where G. W. lives?"

"Naw, but I can guess. One o' them palaces on Jefferson Avenue." (Continued on page 164)

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## Whirling Wheels

(Continued from page 163)

"Guess again," snapped the other. "He lives in a furnished room, you sneaking tongue-waver."

He was wrong, for by that time Gil had taken a comfortable house and installed his wife and Gil, Jr., in it, but it made a good story. It failed, however, to impress the growler. He went on, for some of them seemed to be listening, he thought, to what he was saying! Until a day when G. W. himself happened to pass by, when he broke into such a stream of foul abuse that those who heard dropped their tools.

"Who you talkin' about?" demanded one.

"Him, the—." More of the same, and sock! His evil tongue was silenced.

Gil heard the commotion, saw the crowd of men gathered in the middle of the assembly line, and hurried up with Mac.

"What's wrong?"

"Aw, nothin'. This fool was talkin' too much with his mouth—the loose-jawed son of a back-bitin' scorpion! I slugged him."

"What was he saying?"

"Talkin' out o' turn; namin' names. Tryin' to get us to quit, I guess."

Gil's eyes narrowed. "Throw some water on him."

THEY did, aplenty, and the man sat up wringing wet, to meet the cold eyes of the man he had maligned.

"What's your name?" demanded Gil. The drenched one gave it. "And who are you working for?"

"You; who do you think I'm workin' for?"

"Nobody else?" The man's eyes wavered, and Gil began to entertain a suspicion. "Real sure about that? Maybe I'd better let these boys go ahead."

"Sure! Let me at him," growled the man who had struck. "I'll polish him off!"

"Nobody else?" repeated Gil.

The man muttered, "Gimme my time; I'm gonna get out o' this hell hole."

Gil was convinced. "All right, boys; go ahead," he said, and they started for the trouble maker in a body. At which he yowled, and begged for mercy. "I'm workin' for Wenden," he confessed. "Take 'em off!"

Gil managed with difficulty to get between him and the mob.

"Never mind, boys," he said. "Much obliged. I'd like to deliver him to Wenden in person."

AND didn't that make a hit! Gil piled that sopping wreck into his four-cylinder runabout—it was a four then—and dumped him out in front of the ornate Wenden lobby entrance.

"Go on in," he snapped. "And tell that hellion in there that if he starts anything like this again I'll bring my whole plant over here and clean him out."

And that was all over town before night. No, it was not safe to play with G. W., or any of the crowd out there—and by that time it had got to be quite a crowd.

At first there had been only the assembly line, but now, with two other wings run up alongside the first, they were making their motors again and beginning on transmissions. Gil had bought out the machine shop that had made his engines and moved the whole thing over. Then, when the four came along . . .

It was a beauty, that four. Infinitely better than the one Jim Wenden had bluffed him out of. It was an L-head, whereas Jim's was T-head; that made a big difference, though at the time Gil hadn't thought so. The first four—the one Jim "got"—had been developed out of Gil's first single-cylinder engine, and because its two valves had been on opposite sides of the cylinder, it had grown into a T-head that called (Continued on page 165)

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## Whirling Wheels

*(Continued from page 164)*

for two camshafts. This second engine had been based on the double opposed engine, which had its valves side by side; hence it was an L-head with only one camshaft, and was simpler in proportion.

The four cylinders were cast separately, and mounted on a heavy cast-iron base, with three ample crank shaft bearings. The flywheel was behind, with a cone clutch working in it; the drive gears for the camshaft were in front, exposed for easy timing. It turned up five hundred revolutions a minute, but only at racing speed, for the gear ratio of the selective, sliding gear transmission, which was set just in front of the differential, kept the turnover down around four hundred as a maximum. There had been a little trouble with lubrication at first, but that had been solved by increasing the number of feed pipes from the lubricator, which was now set on the dash with glass tubes through which the driver could detect any failure in the feed. And in addition Gil had attached spoons to the bottoms of his connecting rods, with the result that they not only dipped oil for their bearings but splashed it, so that his cylinder walls and cams received plenty.

GIL used a King of Belgium body on that model. It had appeared at the 1903 show, a French model, and had taken them all by storm. The driver's seat was low, with the gear shift levers and wheel on the right; the tonneau seats were almost a foot higher. That enabled the tonneau passengers to act the part of kings, and look out with unobstructed view over the heads of the front-seat occupants. The upward, backward flare of the body was a graceful series of curves, while the forward thrust of the hood made an excellent prow. There was a full-height radiator of the honey-comb variety in front, with a water reservoir in the top of it and a fan behind it, driven from the camshaft gears. Too large a fan, they discovered after the first two hundred jobs had gone into service and reports began to come to Wally; it kept the engine too cool. So they eliminated the pump feed and made the system thermosiphon, the heat alone causing the water to circulate. And in addition, Gil added head lamps as standard equipment without extra charge—and shipped 2500 Herricks that year.

The inclusion of headlamps as standard equipment brought a yowl from Jim Wenden, in the shape of an advertisement:

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"And that," said Gil Herrick when Andrews had shown it to him, "is about the kind of a stunt Jim Wenden would be expected to do. How many machines did he sell this year?"

"As near as I can guess, about twenty-five hundred. A. L. A. M. doesn't publish its reports, you know."

Gil knew, and smiled thoughtfully. He had seen the A. L. A. M. board room in New York—from the outside. Andrews had pointed it out to him during the show of the year before.

"The meeting place of the mighty," he had said with a chuckle. "Where only the chosen of God—or Jim Wenden—may enter."

The room was on the top floor of a skyscraper in Forty-second Street near Madison. The eaves of the roof above it, for a distance of half the building on either side, were fenced with a strong steel picket fence, with wicked barbs at the top. This was to prevent the spying or eavesdropping. *(Continued on page 166)*

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## Whirling Wheels

(Continued from page 165)

of any envious outsiders during a conference. "Not that I want to join," Gil had said reflectively. "I'm not itching to pay one and a quarter percent of our selling price to a bunch that haven't got a leg to stand on, but—Jim Wenden said I couldn't get in."

Jim Wenden had said a good many things that day in Fosdick's room. And none of them had come true. The Herrick Automobile Company was not exactly out of business—yet. It, together with nineteen other companies, had formed a rival association—The American Motor Car Manufacturer's Association, and was exhibiting very profitably in the Grand Central Palace, while Wenden and his association were holding forth at the Garden.

"And now he says we're hiding behind Ford's skirts," mused Gil. "Says if Ford hadn't entered suit to break the Selden patent they'd have been suing us. Well—they don't publish reports, but I'll get into the A.L.A.M."

And he did, that very year. "It's easy," said Bob Legg, who hadn't forgotten his law. "All you have to do is buy someone's license. They're supposed to be limited, but they're transferable."

WHICH is what Gil did. Already there had been several demises in the automobile game, and membership in the A. L. A. M. didn't carry any insurance. There was one little outfit that had fallen by the wayside, and its receiver was anxious to collect some cash. One day, when the "Ins" were gathered about their director's table, in walked Gil.

"How'd you get in here?" demanded Jim from the head of the table.

Gil grinned. "Walked in," said he. "Here's my license; want to see it?"

"It ain't legal!"

"Ever read it—or can you read?"

"You get out!"

"What'll you give me to get out? The license is for sale—now that I'm in."

"Not a cent! But you'll get a sweet bill for back royalties due!"

"Which I won't pay. I'm the only member you've got that has no accountability," said Gil with an air. "Because I don't like the looks of your chairman, gentlemen, I'm going to sell out my license. Let's see; there are one or two others you don't like, aren't there, Jim. Besides me? I think I'll sell it to—"

"How much?" demanded Jim.

"Well, it cost me five hundred," Gil thought aloud. "Suppose—oh, two thousand ought to cover it all."

AND after much more of similar nature, Jim bought. For one thousand dollars—an item of news that somehow found wide circulation among the players of The Game.

"I'm afraid that's rather foolhardy," was Oliver H. Marston's comment when he heard it. He was not unaware of the matters between Gil and Jim and—at first—had chuckled. Now—"Two can play at that game, you know. Wenden can make it mighty uncomfortable for you, too." It was a warning.

But Gil laughed. "With my gang?" and shrugged. "Any time he wants a fight, all he's got to do is start one."

Which was a pretty cocky thing to say, and no one knew it better than wise old Oliver H. Marston. Youth, and success—added together, they made a combination that tended toward conceit. He had seen many a good man wrecked along that route; it would be a shame to see Gil's well-deserved success piled on similar rocks. Bad business, this quick success! There were not a few derelicts on the seas of speed manufacture already.

"Tend to your knitting, young man." It was as near to an

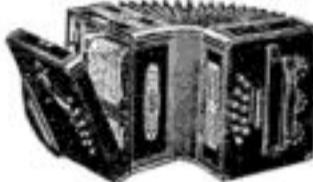
(Continued on page 167)



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## Whirling Wheels

(Continued from page 168)

order as the old gentleman had ever given; the bushy white brows were drawn down. "Don't forget you aren't out of the woods yet. Not by a long ways."

Not that Gil was not tending to his knitting; he was. He had only just undertaken a very radical step—standardization.

"There's too much time lost making parts fit, Mac," was the thought he had just expressed, the result of many a keen-eyed observation, not only of cost sheets but of factory methods. "Too much filing. We're going to stop that. We'll set up a practice of machining limits and inspections and hold 'em to it."

Mac threw up his hands when he understood what was planned, and Gil knew why. Not so long before, when Gil had been mulling over the idea, they had been standing in the engine assembly section watching the painful process of scraping in bearings, and Gil had asked him just how tight a bearing should be. Mac had scratched his bristles in a thoughtful way and said: "Well, Mister Herrick, a bearing should be *loose*."

NOW Gil knew what that meant. Mac had intended to convey the fact that a bearing should fit snugly without binding. It was a matter of the "feel" of the bearing. But what Gil was planning to do was to establish a definite standard of "looseness" in thousandths of an inch. And when he said so—

"Mister Her-r-ick, it'll ruin us! Tolerances by thousandths—why, we'll reject more than we make!"

"Not with tight machines—and a tool room big enough to keep the tools in shape. That's the next step, Mac; go to it."

And Mac did, reluctantly enough, but with Gil there to help at every step. And the following year they staged a demonstration that convinced not only Mac but the whole world.

Under the watchful eyes of officials of the American Automobile Association, three cars were selected at random from the assembly line and completely torn down, the parts packed in boxes. These were shipped to New York during show week and, in the presence of a large crowd, another group of workmen reassembled them. No files were used, no attempt made to fit parts. The mechanics simply put three cars together, then drove them through the streets without the slightest sign of trouble. And five thousand of the Herrick four, Model 1906, were sold that year.

And Jim Wenden—"Well, well! Here's the standardized kid!" he bawled one day in the Pontchartrain bar. They met many times, of course; their trails were bound to cross within the narrow limits of a city and the lobbies of a hotel where the automobile world gathered. But they seldom exchanged words. This time Jim was slightly under the influence. There was a sly look in his eyes and his great voice, booming across the room, stopped all talk. "How's all the little thousandths? Save many today?"

"I HAVEN'T counted them yet," was Gil's reply, quite audible in the silence. "They'll show up at the end of the month—on the balance sheet. And how's the pants business? I see you're throwing in a vest these days."

A ripple of laughter went through the room. Jim not only had accepted Gil's lead of supplying headlamps; he was including also the newly devised acetylene generator. Jim tossed down a drink and bellowed:

"The standardized car—with a forty-mile speed limit! Nice bus for the old ladies, boys; step right up an' buy a Herrick!"

Gil's retort was ready. "High-gear'd bike talk again?" said he.

"No, but I got a (Continued on page 168)

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## Whirling Wheels

*(Continued from page 167)*

wagon for the Vanderbilt cup that'll skin anything you can make!"

"Then you must have a good hired man to drive it."

"Don't you think it, my boy! I'm driving it myself, and if there's any half-sized bicycle mechanic around here that—"

"You'll come in second," was the way Gil stopped that speech, and he turned on his heel and went out.

After which big Jim Wenden celebrated. He picked up a bottle that stood beside his elbow, waved it over his head and hurled it squarely into the center of the great mirror that covered the wall. Then he shouted:

"Yay, boys, I got him! Send the bill to me; I'll buy you a dozen new mirrors! Drinks on me, boys; I got him!"

Which, at that moment, seemed a most extraordinary thing to say. Got him, yes; if making G. W. throw down a challenge was what he meant. But why celebrate that? There was a race to drive before he was entitled to celebrate. It was not until some months afterward that they knew what Jim meant.

What is Jim Wenden's mysterious scheme to "get" Gil? Will he succeed? In next month's installment Gil Herrick comes to the turning point in his career. And that race—you never have seen nor read of one quite so thrilling and dramatic.

## When Nature Starts You Seeing Things

*(Continued from page 38)*

downward. It is simply the opposite of the effect noted in the desert mirage, where the light, in traveling from cold to warm air, is bent away from the earth.

Sometimes the layer of warm air ascends to great heights in the atmosphere, giving rise to the most striking of all mirages—known as a "loom." Here objects far beyond the normal range of vision and even below the horizon appear in the sky.

THIS was the phenomenon that recently treated Cape May, N. J., to what was described as one of the most extraordinary ocean mirages seen along the coast in years. Sand dunes thirteen miles away, at the Delaware Breakwater on the opposite side of Delaware Bay, were clearly seen as an image in the sky. Other "looms" in this country have lifted the Grand Canyon of Arizona into view from below the horizon, and have elevated the image of Milwaukee, Wis., above Lake Michigan. Sometimes cities and scenes lifted into view are greatly magnified, as if the observer were looking through a telescope, due to the freaks of the atmosphere that give it the quality of a powerful lens.

"Looms" are more common in Arctic regions, where they are the bane of aviators. A series of these weird phenomena wrecked the plane of Major F. L. Martin, army aviator, in an Alaskan flight. After a hair-raising experience in dodging an imaginary mountain that "loomed" directly in front of his speeding craft, Major Martin encountered the real mountain unexpectedly and made a forced landing among its crags. Unhurt but lost amid the icy slopes, he and his companion crawled from the wreckage and wandered for days until natives rescued them.

But such a mirage may serve a useful end as well. One of them enabled Captain Scott in 1902 to know the appearance of a portion of the Antarctic which was even without the range of his telescope. *(Continued on page 169)*

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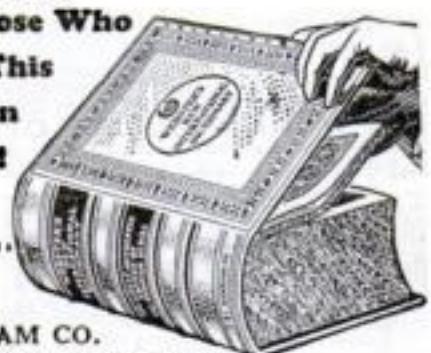
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## When Nature Starts You Seeing Things

(Continued from page 168)

From his observations of an image high in the air of mountains extending south of Mount Longstaff, he concluded the range ran in the same direction for at least seventy miles. Scott's deduction was proved accurate by Amundsen when in 1911 he made his sensational dash for the South Pole.

Because of the lofty position of the heated layer of air, rays of light from objects below the horizon, which cannot ordinarily reach the eye, pass through it. The light rays from far distant objects, which normally shoot into the air unseen, are bent back toward the earth until they strike the eye. Only the upright image is visible.

IT IS generally conceded, since D. B. MacMillan's exploration in 1915, that Peary's Crocker Land was a loom of Arctic ice. MacMillan's description of it is amazing:

"Great heavens, what a land! Hills, valleys, snow-capped peaks, extending through at least 120 degrees of the horizon . . . As we proceeded, it gradually changed its appearance . . . finally at night disappearing altogether."

Often two, three or even more layers of warm air, separated by zones of cooler air, occur and give rise to what is known as the multiple mirage. Then a series of images of distant objects are seen, one atop the other, extending high into the heavens. The images at the top and bottom are in an erect position, while all the intervening ones are inverted regardless of the number.

Vilhjalmur Stefansson, whose books on the Arctic are classic, described to me a multiple mirage which led his companion, Storkerson, miles out of his course in the Far North. Storkerson saw what he thought were towering cliffs fifteen or twenty miles away. As he advanced to examine them, they receded, getting lower and lower until they sank below the horizon. Miles of tramping revealed the "bold cliffs" to be only low mud banks. The stratified atmosphere had multiplied the images of these flat banks until they apparently rose like majestic palisades. Stefansson further told me that this same atmospheric condition frequently makes small rocks appear like huge boulders or high pinnacles. Sometimes, he said, small stones take on the height of men, and slight variations in the heat lend them the appearance of a marching army.

THE most famous mirage of all time, called **T** by the Italians Fata Morgana from the fairy of King Arthur legends, is frequent on the Sicilian coast and at Naples. Here, usually in the morning, beautiful cities appear in the sky. Pinnacles and towers reach dizzy heights, and castles of fantastic shapes jut upward. Suddenly all changes; the columns lose their height, and arcades and vaults appear. These fade, and again castles and colonnades develop.

The Fata Morgana is the elevation of objects on an opposite shore into pinnacles and columns. It is due to the presence of curved and irregular layers of air of different temperatures—a condition peculiar over the water in that vicinity. Instead of being bent in plane layers of air, as in other mirages, the light rays are bent in broken and repeated layers. The result is magnification and distortion, but chiefly vertical magnification. Ordinary objects are thus twisted and combined to form an ever-changing fairyland.

Fata Morgana is also often noted in polar regions. Both Scott and Mawson have reported that such abnormal atmospheric conditions in the Antarctic will elevate small projections of ice, a foot or two high, into lofty castles and towers.

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## You've Got Your Patent, But—

(Continued from page 26)

in producing something new, is not patentable. If, however, the new arrangement results in something never before attained, the courts will hold the patent valid. Mere substitution of other material which brings about the same result is not patentable, but if it brings about new and better results, it is. As an example, the mere mixture of carbon and iron to make steel would not be patentable, because the various mixtures of carbon and iron have long been known; but if some other metal were added to produce in the steel new properties, such as to make the steel rustproof, the addition would be patentable.

A CASE in point is the Edison incandescent light patent. This light differed from the earlier carbon filament burners only in that Edison made his carbon filament one sixtieth of an inch or less in diameter, while the earlier patents specified a diameter of one thirty-second inch or more. Ordinarily, this would not be a patentable difference, but that reduction of one half in the diameter of the filament increased the resistance four times and reduced the radiating surface two times, thus increasing the ratio of resistance to radiation eight times. It was this point which made the burner practical, whereas earlier burners were impractical. In other words, Edison's changes were in the basic laws governing the flow of current through a resistance filament, and were therefore patentable.

Next, only ideas are patentable, and an idea need not necessarily be practical in order to be valid. For instance, the patent on the first circular sawmill was declared nonvalid because it was shown that there had previously been sawmills in existence, which, however, were too small to cut logs. In other words, the patent on the original machine covered the idea of the circular sawmill, even though the machine itself would not cut a log.

A plumber proposed to thread pipe for its entire length so pieces of any size could be cut off and joined, but a patent had already been granted upon the idea of threading each end of a pipe, and the patent office held that threading the whole pipe was nothing more than a logical extension of this original idea.

The combination of two or more substances or ideas of known qualities is not patentable when the combination does not result in something not previously known. As an example of this type of patent, which has been declared invalid, I might mention the putting of rubber on the end of a lead pencil. The court held that neither the rubber nor the pencil acquired any new properties by reason of the combination.

THE famous Selden patent on automobiles, which was declared invalid in 1911, is probably the best known example of a patent upon a combination of previously known elements.

Selden applied for his patent in 1879, the papers, however, lying in the patent office for sixteen years, during which the inventor amended them from time to time to include new automotive developments. The patent was finally granted in 1895 and until 1911 Selden collected royalties on every car built. Then a number of automobile companies refused to pay further royalties and Selden sued for infringement.

All of Selden's claims were broad and all-inclusive. They did not state any particular type of body clutch, engine or steering mechanism but confined themselves to generalities which covered every type of device which Selden thought would be used in the future automobile. The court held that all the claims of the patent were old, and that the new combination of old ideas did not produce any new result of new co-operative action. (Continued on page 171)

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Any man who will take the trouble to expertly learn the mechanical and electrical end of automotive "maintenance" is sitting pretty these days. For up-keep has become the BIG-MONEY end of the great auto industry. They only build 3 million new cars a year, but there are 22 million autos, trucks, tractors, taxis and buses TO SERVICE.

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## You've Got Your Patent, But—

(Continued from page 170)

The patent was therefore declared invalid. The court concluded Selden "erred by making his claims too broad."

Lastly, prior existence of an idea will invalidate a patent, even though this idea was not recorded in writing or patented. If it can be proved that the idea was in use previous to the application for the patent, the claim becomes void.

A case in point is the trolley pole of a street car, the patent upon which was declared invalid on the ground that the idea had been in previous use, back in Colonial days, though it had not been written nor patented. The idea was held to be nothing more than a modification of the method of raising water from a well by means of a long pole, or sweep, counterbalanced by a large weight on the end opposite the bucket of water.

A prospective patentee should determine, before applying for papers, what are the patentable features of his idea. I once worked out a process for dehydrating fruits and vegetables by passing them through a series of tunnels, through which were passed currents of air of definite temperature and humidity. Knowing nothing of patents at the time, I applied for one on the machine and it was granted. In the meantime, another inventor, working independently in another part of the country on the same idea, was granted a process patent. In other words, his patent covered the process of dehydration while mine merely covered a machine for carrying out this process. I therefore could not use my machine without infringing his process.

SOMETIMES more than one patent is necessary to cover the different aspects of one idea. For instance, the steel fireproof curtains, such as are used in theaters and as fire doors in buildings to confine a fire to one section of a building, are covered by more than a dozen patents.

And there you have all there is to this business of patents. All you have to do to make a million dollars is to get a valid patent upon a commercially profitable idea. If you can do that, your fortune is made.

## Who Did the Shooting?

(Continued from page 22)

position on the two shell caps. In any firearm there is a certain amount of play, and the shells do not always come back against the breech in exactly the same position; nor does the firing pin always strike the exact center of the primer. The positions of the individual markings in relation to the imprint as a whole are, however, identical.

Under the microscope I compared this murder shell with other test shells fired from the Sacco pistol. Although the latter were somewhat fouled and dirty, the identity was again evident; so evident in fact, that the defense expert, looking through the microscope exclaimed:

"Well, what do you know about that?" Finally I tested a fourth murder shell in the same manner. There was no similarity.

Then I applied the tests to the four bullets from the body of Berardelli, comparing each with test bullets fired from the Sacco pistol into a box of sawdust. In each case the bullets were placed horizontally under the comparison microscope in little holders which enabled them to be rotated.

The first one I examined, known in the evidence as fatal bullet No. 3, was considerably fouled and corroded, but the microscope revealed beyond question that it had come from Sacco's weapon. First, the marks of the rifling grooves were of the same width and the same angle as those (Continued on page 172)



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COMPARE the small drawing at the left made by George Holman Ray before studying with us and the Cover Design at the right which was made recently. Note the wonderful improvement brought about by the right kind of training.

His is an interesting story. When eighteen, he was employed as Indian interpreter and storekeeper at Hudson's Bay, one hundred miles beyond the railroad. In summer his mail was carried in by canoe; in winter by dog sledge.

He says: "My cousin sent me a magazine which contained an advertisement telling about the Federal Course. I was fortunate enough to get several foxes in trapping I was doing with an old Indian. I used the money to start the course. I had absolutely no other art training except the Federal lessons.

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## Who Did the Shooting?

(Continued from page 171)

of the test bullets. In addition there appeared tiny scratches which were identical. In particular, the microscope revealed one very prominent gouge which matched perfectly. Rotating the bullets, I compared them groove by groove. I invited the defense expert to look into the microscope.

"That," he said, referring to fatal bullet No. 3, "could not have come from any other gun."

None of the other body bullets matched. For example, one of them, bullet No. 2, obviously came through a right-hand twist pistol, whereas Sacco's was left-hand twist.

RETURNING again to fatal bullet No. 3, at the defense expert's request I compared it with other test bullets, one by one. The marks of identity—tiny scratches and grooves—matched in every case.

Further evidence in corroboration was the fact that fatal bullet No. 3 was of an obsolete type, manufactured with grooving near the base known as the "cannelure"—a remnant of the old days of lead bullets. Three bullets of this type were found on Sacco's person.

No doubt many persons, including some officials, are skeptical of this sort of comparison evidence. "Guns leave their fingerprints? Nonsense!" you may hear them say. Yet only twenty-five years ago everybody ridiculed Joseph A. Faurot, former deputy police commissioner of New York, for trying to secure recognition of human fingerprinting as a means of identification. Faurot lived to see the fingerprint system adopted throughout the world, and also to say of the new method of identifying bullets and firearms:

"It is a science, in my opinion, as infallible, as practicable, as revolutionary, and as valuable in criminology as fingerprinting itself."

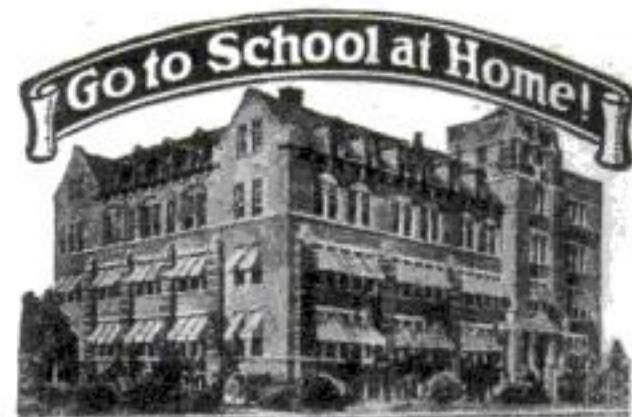
Today in our laboratories in New York City we have records of the shop standards entering into the manufacture of virtually every modern revolver and automatic pistol of both American and foreign makes, a collection of many hundreds of bullets of all calibers and types, fired through arms of nearly every make; and about five hundred revolvers and pistols from all parts of the globe. Given any bullet, we are ordinarily able to determine within a short time exactly what kind of weapon fired it; and if that weapon is eventually traced and found, we can identify it with scientific exactness.

With a remarkable instrument called a helixometer, designed by Mr. Fisher, we can examine the entire interior of the barrel of a weapon. It reveals every flaw, fouling deposit or rust spot that might be reproduced on a bullet fired through it. Moreover, by studying the deposits within the barrel we can determine the approximate time when the weapon was last fired, the kind of powder in the cartridges (black or smokeless), and sometimes the type of bullet.

STILL another valuable instrument is a micrometer microscope with which we can measure the width of a rifling groove to the ten thousandth of an inch. With the same accuracy we can measure the depth of the groove, its angle, and the pitch of the spiral.

We have collected specimens of the different kinds of powder grains used by virtually every manufacturer of projectiles. When a pistol is fired, usually some powder grains are discharged unburned. At close range some of these grains may lodge in the flesh of a victim. By examination and comparison with the specimen grains, we can determine the manufacturer of the powder charge in the fatal cartridge.

By such methods we are supplanting "expert opinion" with facts. Our goal is that innocent men shall not be sent to their deaths, nor guilty men acquitted, by testimony unsubstantiated by the facts of exact science.



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..... Electric Light & Power	..... High School Graduate
..... General Education	..... Wireless Radio
..... Vocational Guidance	..... Undecided

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## Whole Rooms That Fold Up

(Continued from page 68)

metal bins for flour and other containers that may be supplied with cabinets, scientific housekeepers advise an array of labeled jars of sizes uniform in several series to hold supplies of spices, other cooking accessories and minor foodstuffs. The best method is to obtain glass jars of uniform diameter with metal screw tops and attach homemade labels.

Kitchen sinks used to be just what the name implies. Now they commonly include a ribbed porcelain drain board on one or both sides. There is also a one-piece porcelain sink combined with a "laundry tray," otherwise a small tub, which is covered with a wood or aluminum drain board when not in use. We now have a tiny washing machine that fits into a sink and operates by water pressure, being connected to the faucet by a hose. An inner drum rocks automatically with the flow of hot, cold or tempered water. It is a useful accessory for doing small laundry jobs and for valued items which the housekeeper will not entrust to a public laundry.

THE modern bathroom has become smaller and better. The writer's conviction on this point was fortified after he had seen the bathrooms in the grandiose New York palace of the late Senator Clark. This \$3,000,000 structure was barely two decades old when scrapped to make room for an apartment house. Its bathing quarters were cumbrously elegant and inconveniently spacious. The fixtures were monumental and awkward, in some respects fantastic. Most hotels and many homes today have bathrooms more truly luxurious than unlimited wealth could purchase a generation ago.

A small tub is now favored by many persons. It serves well in connection with the preferred shower, whether the latter is a fixed feature or a spray hose. There are shower curtains of cotton duck and of rubberized silky cloth. If you have trouble mixing the shower just right, put in a thermostatic mixing valve.

The built-in tub formerly involved costly tile laying; now tubs are ready made in this style, fitting tightly at floor and walls without unsanitary space beside or below. There are models and various sizes to fit a corner or a recess. The over-all lengths are commonly four and one half to six feet with usual over-all width around thirty inches.

A glass or porcelain handgrip attached to the wall beside the tub is a device of luxury and safety. The wall-inset porcelain soap dish is another refinement. Glass rods for towels are easy to keep clean. A toothbrush holder, a soap dish and a drinking glass holder, all of porcelain, belong at the lavatory. We must not forget the medicine cabinet of porcelain surface and glass shelves and maybe a glass door which is attached to or, better, inset in the wall.

IT IS not splurging to have such fixtures and accessories in a modest home. Metal and wood soon deteriorate in a bathroom, become unsightly and unsanitary. Glass and porcelain and heavily nickel or chromium coated brass—the latter being a new improvement—are highly desirable.

Tile is usually the preferred surface for bathroom walls and floor. On account of its expense it is often given up for materials that resemble it and in measure partake of its virtues. There are glazed and oilcloth wall papers which give the effect of white tiling. A wood fiber wallboard with hidden, self-clinching fastening at the back is marked off in squares, and when finished in white enamel appears to be tile. There are floor linoleums which resemble hand-set ceramics. Rubber and cork tile may be laid either over wood or concrete.

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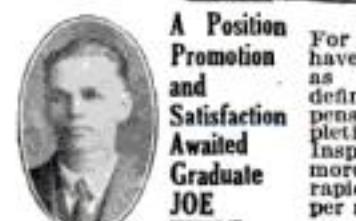
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Thanking you very kindly for what you have done for me and the personal interest shown me, from the day the first lesson arrived to the present hour, I am

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Dept. 2411-E 1117-15th St., N. W. Washington, D. C.

## Reducing the Universe to Inches

(Continued from page 16)

unit, the "light year." This concept is familiar to everyone. Expressions like "fifteen minutes" walk from the station," "two hours by train," and the like convey a real meaning, although time and speed of travel are substituted for the specific measurement of distance. Similarly, the "light year" represents the distance traveled in one year by light at the tremendous speed of 186,000 miles a second. It takes a little more than a second for light to reach us from the moon, eight minutes from the sun, and four hours from Neptune. The light just reaching us from the nearest star, however, left it four years ago. In other words, that star is four light years distant from us.

Only to a distance of about 300 light years can the method of surveying by triangulation be applied. For a long time astronomers had no means of sounding the depths of space beyond that point. Only a tiny fraction of the stars visible in their telescopes could be measured and studied. But now, through ingenious methods first developed at the Mount Wilson Observatory, they have learned to calculate the distance of any star or swarm of stars whose light can be caught by the telescope. For the new yardstick is the light of the star itself! It is based on the physical law that the intensity of light varies inversely as the square of its distance from the source.

**I**F YOU can determine that the light in your room is nine times brighter at the lamp bulb than it is where you are standing, then you can figure that you are standing just three feet away from it. Similarly, the difference between the *true* brightness of a star and its *apparent* brightness as observed through a telescope on earth, is a measure of its distance from us. It was this method which Dr. Maxwell employed in computing his new figures of the size of the universe.

But how is it possible, when a star is so far away, to learn its true brightness? It is done by remarkable instruments for determining its temperature and size. Obviously, the hotter a star is, the more light it will radiate. Its temperature, therefore, indicates its surface brightness. If, then, the size of the star can be found, the two factors considered together tell its total brightness or candlepower.

The temperature of a star is known by its color. When you look at the stars you will see that they vary in color from red to blue. The red ones are the coolest; the blue, the hottest.

The size can be calculated by determining the substances which compose a star and therefore its density. This is achieved by an instrument called the spectrograph, one of the most useful tools of the astronomer. It is an arrangement of prisms which break up the light from a star into the rainbow colors which compose it. The record of the rainbow, made on a photographic plate, is known as the spectrum. Study of the spectrum and its arrangement of colors reveals the nature and quantity of chemical elements composing the star; hence its density and probable size.

**D**R. MAXWELL employed a new type of spectrograph, or spectrograph, in which the prisms and lenses are made of quartz, so that the ultra-violet region of the spectrum, to which ordinary glass is opaque, may be photographed. This instrument he fitted on the Crossley reflector of the Lick Observatory. Two of the spectra of faint stars obtained in this manner are shown in accompanying photographs. Notice in each case the dark lines crossing the band of light. These are caused by different elements in the star's atmosphere. In their position, size and arrangement, the astronomer recognizes hydrogen, iron, calcium and so on. In general you will see that the two

spectra illustrated are quite similar. This is because the two stars of which they are records have virtually the same temperatures. But there are a few marked differences. For example, a dark band near the center, which is strong in one spectrum and weak in the other, shows the presence of a compound of carbon and nitrogen. Since it is known that this compound is decomposed by high pressure, it is easy to determine that the star which contains the most of it is less dense than the other. Indeed, by exact measurements of the intensity of this dark band in each case, it is possible to compute just how dense each star actually is and thus, indirectly, to arrive at their sizes.

**D**R. MAXWELL succeeded in photographing and measuring stars 1600 times too faint to be seen by the naked eye. Since there are more than six million such stars, he could not, of course, study them all. Instead, he adopted the method of "sampling" a few of them and so arriving at an average. The distances of some 2000 faint stars were thus measured from their spectra. The farthest ones he reached were about 100 quadrillion miles from us; in other words, the light which entered the telescope and blackened Dr. Maxwell's photographic plate left the star 15,000 years before!

From these measurements, observing the rate at which the number of stars thins out near the limits of the Milky Way, Dr. Maxwell arrived at his figure of 60,000 light years as the diameter of the universe. Though somewhat smaller than previous calculations—200,000 to 300,000 light years—experts believe it is one of the most reliable estimates yet made.

And what incomparable wonders lie beyond? Countless other universes—billions of them, we are told—at inconceivable distances yet to be surveyed!

Though it takes a very keen eye to see as many as ten of these far island universes without the aid of a telescope, in recent years many thousands of them have been photographed and catalogued. It is estimated that a very powerful reflector, like that at Mount Wilson, is capable of photographing several millions of them. Yet thus far it has been possible to measure and study only a few. Nearest of all and the oldest, for example, are the Magellanic Clouds, 100,000 light years distant. Beyond are the two great spiral nebulae in Andromeda and Triangulum, a million light years away.

But the vast number of nebulae are beyond the reach of measurement, even with the most powerful reflector on earth. New methods will be required if surveyors are to penetrate into infinity 100,000,000 light years and more.

Classification of known nebulae according to their form and observation of regularities in their behavior have led to this theory:

**A** UNIVERSE begins as a great chaotic mass of glowing gas in the form of a rotating sphere. After ages, its rotation causes it to flatten out in the shape of a lens. More ages pass, and then gigantic upheavals begin to take place within it. Eruptions throw out solid material from the inside. Great streamers fly out in the shape of spiral arms. At last stars appear on the outside. After trillions of years the mass of gas has been entirely transformed.

Gradually the spiral arms unwind, producing more and more stars. Finally the arms disappear altogether, and all that is left is a vast swarm of separate stars.

But what happens next? Possibly, we are told, some of the stars will begin to wander off from the parent universe and venture into space beyond. Most of them, though, will remain until they die. The smaller stars will die first, then the larger ones. Finally the entire universe will be a mass of embers.

THIS ONE



2Z3C-CDB-CJHA



3 Year  
Guarantee

8 tube ~ one dial

**MIRACO**  
TRADE MARK REGISTERED

MAGNIFICENT TONE ~ SUPER SELECTIVE ~ POWERFUL DISTANCE GETTER

 All Electrified or Battery Set!

America's big, old, reliable Radio Corporation\* (8th successful year) guarantees its big, powerful, latest 6, 7 and 8 tube Miraco sets to give one of "the finest, most enjoyable performances obtainable in high grade radios." Unless 30 days' use in your home thoroughly delights you with its beautiful, clear cathedral tone, razor-edge selectivity, powerful distance reception, easy operation, etc.—don't buy ill! Your verdict final—absolutely no strings to this. Save or make lots of money on sets and equipment by writing for testimony of nearby users and Amazing Special Factory Offer.

Run from Light Socket or Batteries  
Miraco's work equally fine with "A.C." power

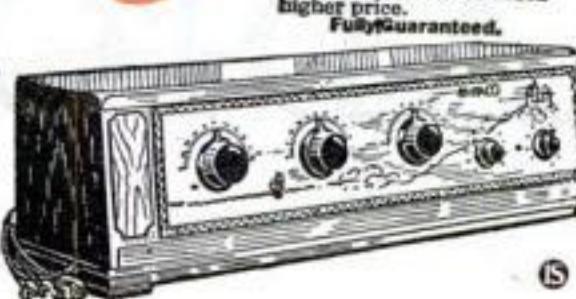
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Famous powerful big Miraco Super 6, 1928 model—ultra selective. Thousands find it outperforms and outdistances sets of much higher price. Fully guaranteed.

Amazing value as 30 Days' Trial Will Prove



6 tube  
Super  
\$36<sup>75</sup>  
RETAIL LIST

FACTORY PRICES - SAVE \$'s  
Choice of beautiful cabinets offered

TRY IT 30  
DAYS FREE

BEFORE YOU BUY

ALL  
METAL  
SHIELDED  
CHASSIS

Only  
\$69<sup>75</sup>

Retail List  
Completely  
Assembled

with batteries. Take your choice. Many thousands of Miraco users—who bought after thorough comparisons—testify they enjoy programs Coast to Coast, Canada to Mexico, good and clear—with magnificent cathedral tone quality. Don't confuse Miraco's with cheap radios. Miraco's are built of thoroughly high grade parts, and have the latest approved shielding, metal chassis, etc.

#### Deal Direct with Big Reliable Makers

Your Miraco reaches you completely assembled, rigidly tested, fully guaranteed. Easy to connect and operate. 30 days free trial. 3 year guarantee if you buy. Choice of beautiful consoles [with latest built-in orthophonic type speakers having 8 feet of tone travel] and table cabinets, also offered. You take no risk, you insure satisfaction, you enjoy rock-bottom money-saving prices by dealing direct with one of radio's oldest, most successful builders of fine sets.

*USER-AGENTS! Make big profits showing your Miraco set to friends*

\*MIDWEST RADIO CORPORATION, Cincinnati, O.

#### BEAUTIFULLY ILLUSTRATED CATALOG AND AMAZING SPECIAL OFFER

SEND NO MONEY.—30 DAYS' TRIAL  
Special Wholesale Price Offer to User-Agents, Bank References and testimony of nearby Miraco users—sent with catalog.

Mail Coupon  
Right  
Now

MIDWEST RADIO CORPORATION  
Pioneer Builders of Sets  
408-A Miraco Building, Cincinnati, Ohio.

Without obligation, send free catalog, AMAZING SPECIAL OFFER, testimony of nearby Miraco users. ( ) User ( ) Agent ( ) Dealer

NAME

ADDRESS

THIS COUPON  
IS NOT  
AN ORDER

*Big Discounts to  
User-Agents*

**7 tube  
one dial  
METAL SHIELDED  
CHASSIS  
\$49<sup>75</sup>  
RETAIL LIST**

MIRACO "Powerplus" sets—both in 8 and 7 tube models—have magnificently beautiful, clear cathedral tone quality. Turn one dial for stations everywhere. Ultra-selective. Miraco multi-staged distance amplification gives "power-plus" on far-off stations. Latest all-metal shielded chassis. Illuminated dial. Fully guaranteed. Try one free for 30 days! Choice of beautiful cabinets.

**Electrify Any Radio  
with  
MIDWEST NO-BATTERY  
"A.C." Light Socket  
Power Units**



Big  
Discounts  
to  
User-Agents  
"A", "B" and "C" power, direct from light socket, without batteries! Write for Midwest prices and discounts. Midwest Units are highest grade—lastingly dependable, quiet in operation, fully guaranteed.

At the first crack  
of the World's Series  
bat....

"You're there with a Crosley!"

The Crosley Radio Corporation:  
Can you explain "balancing"; so folks  
people know that Hazeltine's neutro-  
dyne principle is a wonderful thing.  
If you can make it understandable to  
laymen you're good.  
Yours truly,  
Ft. Wayne Iron Stores  
Co., Ft. Wayne, Ind.

Nature always puts obstacles in our  
way. When men begin to study a new  
invention or discovery they find that  
there are many problems to solve  
before a successful device can be  
built. This was the case with the  
steam engine, the printing press, the  
automobile, the aeroplane, and every  
other major invention that you can  
think of.

The vacuum tube is, perhaps, one of  
the most remarkable inventions ever  
made. We found that we could use  
it to amplify the radio signals.

But when we tried to  
tune these amplifiers,  
so that they would help  
us select the desired  
signal, we found that  
the vacuum had a ten-  
dency to misbehave.

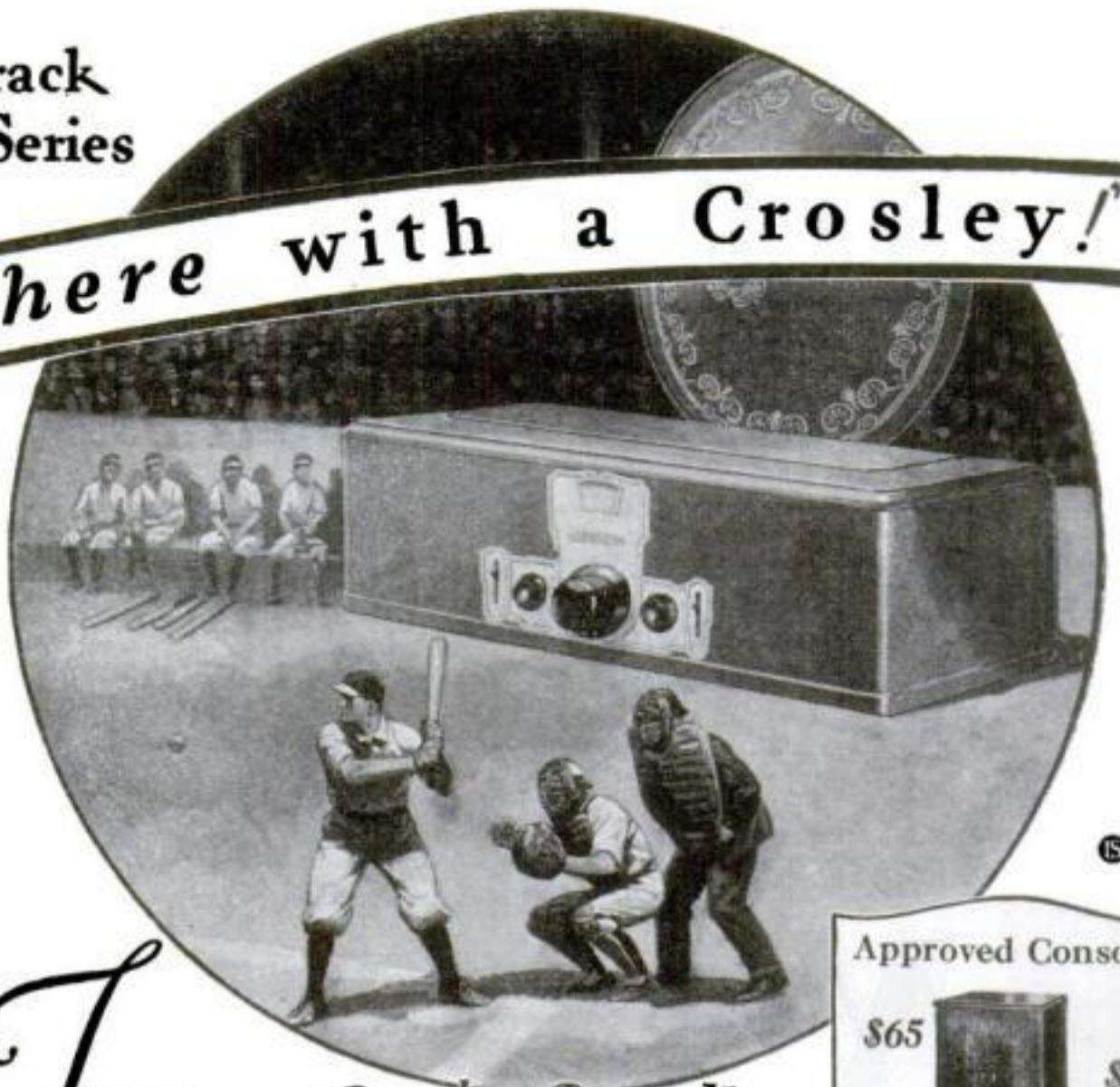
When a tube is used  
to amplify, the output  
voltage is much stronger  
than the input voltage. This is the  
natural result of the  
amplification. But  
there is a path back  
through the tube  
through which some of  
the strong output voltage can get  
back to the input side of the tube.  
This voltage is then again  
amplified and again returns  
getting stronger each time,  
the result being that the  
tube goes wild. It becomes  
a miniature broadcasting  
station on its own hook.

If we can provide a second path from the  
output circuit to the input circuit, so ar-  
ranged that the voltage which comes back  
through this second path is opposed to  
the voltage that comes back through  
the tube itself we  
can prevent the trouble. This is  
called "balancing" because the  
second path is ad-  
justed so  
that it exactly  
balances the  
path through  
the tube.

The  
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tube.

Amplified Sig-  
nals Returning  
to Tube Mixing  
It Up With In-  
coming Signals  
Hazeltine Divides  
Bolshevik Voltages.  
Balancing Each Other  
by Opposing Each  
Other. They Cause  
No Rumpus in the  
Tube and Program  
Signals Go thru  
Amplifier Without  
Interference

centralizing this path  
through the tube  
has several unique  
advantages over all  
the other methods  
that have been pro-  
posed. This is why Crosley radios use  
the Hazeltine "neutrodyne" method.



*THIS new Crosley Bandbox  
6 TUBE RECEIVER de luxe  
is the national radio hit at \$55.*

Its amazing performance is the result of its remarkable construction—the introduction of features found in the most expensive of radios and possibly at \$55 only thru mass production methods, plus the licensing of Crosley for use of the patents, research resources and discoveries of The Radio Corporation of America, The General Electric Co., The Westinghouse Co., The American Telephone & Telegraph Co., and The Hazeltine and Latour Corporations.

Check any radio at any price against these Crosley features—standards of comparison that indicate the Bandbox's superiority.

- 1—Completely shielded coils, condensers and wiring.
- 2—Acumulators for sharpest tuning.
- 3—Completely balanced genuine Neutrodyne.
- 4—Volume Control.
- 5—Single tuning knob.
- 6—Illuminated dial.
- 7—Single cable to outside connections.
- 8—Designed for easy installation in consoles.
- 9—Beautiful frosted brown crystalline finish.

AC model using new R.C.A. AC tubes and working directly from electric light socket through Crosley Power Converter \$65. Power Converter \$60.

The value of this Bandbox receiver and the excellence of its performance can best be judged by seeing it and hearing it at the nearest Crosley dealers. If you cannot locate one of the 16,000 dealers, write Dept 17 for his name and address and Crosley literature.

#### Approved Consoles



Selected by Powel Crosley, Jr., as ideal, acoustically and mechanically for the installation of the Crosley "Bandbox." Genuine Musicones built in. Crosley dealers secure them from their jobbers through H. T. ROBERTS CO., 1340 S. Michigan Ave., Chicago, Ill. Sales Agents for Approved Console Factories: Showers Brothers Company, The Wolf Mfg. Industries.

#### IMPROVED MUSICONES

Musicones improve the reception of any radio set. They are perfect affinities in beauty and reproductive effectiveness for Crosley Radios. A full-table model with brown mahogany finish stands 37 inches high, \$27.50—16-inch Super-Musicone as pictured above with "Bandbox," \$12.75—12-inch Ultra-Musicone, \$9.75.



# GROSLEY RADIO

THE CROSLEY RADIO CORPORATION  
Powel Crosley, Jr., Pres. Cincinnati, Ohio  
Prices slightly higher west of the Rocky Mts.



Crosley is licensed only for  
Radio Amateur, Experimental and  
Broadcast Reception.

 This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



*The amazing hair test proves KRISS-KROSS keenness!*



## *Astonishing Discovery Makes* **ONE RAZOR BLADE GIVE 1500 KEEN SHAVES!**

Here is a truly amazing advance in shaving comfort and economy! Imagine a razor blade so keen that it gives slick, clean shaves for over 5 years! That was the revolutionary experience of one man with KRISS-KROSS. And now the manufacturer makes you one of the most surprising trial offers in shaving history. Read details below.

### **I'll Send You A Test Blade FREE!**

**J**UST think what it means to get 1500 perfect shaves from one blade! No blades to buy for over 5 years! That's exactly what this novel invention did for Mr. M. T. Main of Kenosha, Wisc. He writes, "I have been using KRISS-KROSS for the past 5 years, am still on the same blade, and by the looks of things it will outlast me!"

#### **A New Shaving Secret**

As everyone knows, a keen-edged blade is everything in shaving. KRISS-KROSS blades, manufactured by an exclusive American-invented process, are remarkable. But records like the one reported by Mr. Main are not due entirely to the blade. As he himself says, it is made possible by a startling device called the "KRISS-KROSS super-stropper."

This revolutionary invention prolongs the life of any blade, single or double edge, for months, even years. (The most startling records, however, have been reported when it is used in combination with adjustable, 3-way KRISS-KROSS razor and KRISS-KROSS blades.) It embodies 7 mechanical features that have long baffled inventors. Reproduces automatically the magic diagonal stroke of the master barber. Strops from heavy to light. Notifies you when your blade is done. It's all so nearly human that it's almost uncanny! In just 11 seconds your blade is ready with the keenest cutting edge that steel can take.

G. L. Gibson, Ore., says, "I haven't bought a single blade since I got my KRISS-KROSS 7 years ago." Liddle, Ill., writes, "Have used one KRISS-KROSS blade for 2 years." These are only two letters among thousands, yes, tens of thousands, that pour in, all telling of a super-keeness, a shaving joy that you never dreamed was possible.

I want every man in America to discover how marvelously KRISS-KROSS stropper improves any blade—especially the unique KRISS-KROSS blade. So, for a limited time, I am making the following special test offer.

#### **Make This Free Test**

I will send you absolutely free a brand new KRISS-KROSS blade, treated before mailing on the magic KRISS-KROSS stropper. You will get the biggest surprise of your life when you test its astonishing smoothness and keenness.

As soon as you get it, take a hair between your finger and thumb. Draw the KRISS-KROSS blade across it. Note how the hair simply falls apart, cut through absolutely slick and clean. Next, hold the blade with the edge up and draw a strip of tissue paper gently across it. Watch it flash through the paper without a trace of "pull" or drag. Then try these same tests with the blade you now use. You will instantly see how amazingly different, how tremendously superior the KRISS-KROSS treated blade really is.

#### **Generous Introductory Offer**

#### **—Act Quick**

Decide today to make these free blade tests. See for yourself how keen a blade really can be. Learn what astonishing things KRISS-KROSS super-stropper will do to any kind of blade. Get the facts about my sensational offer of a 3-way razor FREE. You never imagined such shaving comfort could be possible. Such keenness! Such smooth, velvety shaves! So quick, so painless! It's a positive revelation. Discover it today. Clip the coupon. Fill it out. Mail it at once.



#### **Most Remarkable Shaving Invention Ever Patented**

More than just a stropper! A super-stropper and blade rejuvenator! That's KRISS-KROSS! It's for any razor blade except Durhams. Employs famous master-barber diagonal stroke. Eight "lucky leather grooves" help to do the trick in 11 seconds. Strops from heavy to light, automatically. Eliminates  $\frac{1}{4}$  of usual shaving costs. No more bother about remembering to buy new blades. Solves your blade problem, and gives you keen velvet-smooth shaves forever. The coupon brings full details.

Rhodes Mfg. Co., Dept. S-242, 1418 Pendleton Ave., St. Louis, Mo.

Without obligation to me, please send me FREE one (1) KRISS-KROSS blade treated with the super-stropper so I can make the hair and tissue paper tests. Also send me details of the stropper and special FREE RAZOR OFFER.

Name .....

Address .....

Town ..... State .....

Check here if interested in making money as an Authorized KRISS-KROSS Representative.

**Rhodes KRISS KROSS**  
**RHODES MFG. CO. STROPPER**

World's Largest Manufacturers of Mechanical Stroppers

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# THE *New* FRESHMAN ELECTRIC RADIO

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# *Always Ready... Always Right*

The cabinet panelled entirely of genuine mahogany, contains a large cone speaker mounted on a Baffle Board, which is placed in a remarkably resonant tone chamber, rendering exceptionally fine tone quality and "true-to-life" reproduction.

# Freshman EQUAPHASE

## Plug in Your Light Socket and Listen.

**\$185.00**

**COMPLETE READY TO  
OPERATE**

A Freshman development—licensed under patents; R C A—General Electric Co.,—Westinghouse Electric & Mfg. Co. and American Tel. & Tel. Co.

**CHAS. FRESHMAN CO., Inc., Freshman Building, New York**